

A Report Prepared for:

Northwestern Steel and Wire Company
121 Wallace Street
Sterling, Illinois 61081

US EPA RECORDS CENTER REGION 5



1010266

**DESIGN DEVELOPMENT REPORT
STABILIZED POLLUTION CONTROL SLUDGE
LANDFILL EXPANSION
NORTHWESTERN STEEL AND WIRE COMPANY
STERLING, ILLINOIS**

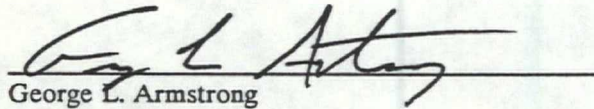
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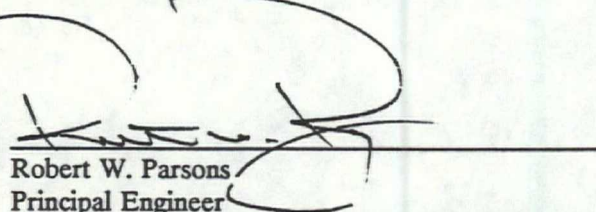
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1.0 INTRODUCTION

Harding Lawson Associates (HLA) was contracted by Northwestern Steel and Wire Company (NSW) to design the expansion to their existing stabilized pollution control (PC) sludge landfill. The landfill is located at NSW's steel mill in Sterling, Illinois. A site vicinity map is presented on Plate 1.1.

The objective of the landfill expansion is to increase the capacity of the existing landfill to the maximum extent feasible. In addition to this, the expanded landfill and operations of the landfill will result in the following benefits:

- Upon closure, the area of the top deck will be significantly less than that for the existing landfill plan. This will reduce the long-term potential for surface water infiltration through the waste;
- Improved storm water management;
- Improved isolation of the waste handling activities;
- Insignificant surface water infiltration into the waste as a result of waste compaction and grading; and
- No new impacts to land which is not currently impacted by the landfill and landfill operations.

This report presents the landfill expansion design concepts. Also included in this report is the basis for various aspects of the design. Drawings presented in this report are not intended for use to guide construction, but are intended to document the proposed landfill expansion plans and gain regulatory agency approval of the plans prior to preparing the construction documents.

In developing the landfill expansion design, HLA conducted a geotechnical investigation of the site to develop design parameters. HLA's geotechnical investigation and results are documented in Appendix A. In addition, HLA prepared an Operations Manual for the landfill which describes the procedures to be followed by the landfill personnel to achieve the goals of the landfill design. The Operations Manual is a separate document.

2.0 BACKGROUND

2.1 Site Description

2.1.1 Location

NSW is located in Whiteside County at 121 Wallace Street, Sterling, Illinois 61081. The property boundaries lie within three townships; Como, Tampico and Sterling. The stabilized PC sludge landfill is located in the southwest region of the NSW site, as highlighted on Plate 1.1.

2.1.2 Topography/Surface Water Run-off

The landfill site is situated in an upland area, between the Rock River hill country and the Green River lowland. The landfill is approximately 750 feet southwest and west of the Rock River. The ground surface elevation adjacent to the landfill ranges from approximately 632 to 640 feet above Mean Sea Level (MSL) datum. The 500-year flood plain elevation of the Rock River at this location is approximately 627 feet above MSL. A topographic map showing the landfill site and immediate vicinity is included as Plate 2.1.

Surface water drainage within the immediate vicinity of the landfill generally flows away from the landfill perimeter by sheet flow.

2.1.3 Geologic Setting

The landfill is located within a glaciated area of northern Illinois. In general, the site is underlain by 25 to 40 feet of overconsolidated glacial till (clays, silts and sands) over limestone. Groundwater occurs at depths of approximately 23 to 28 feet.

Details of the conditions encountered during the HLA geotechnical investigation are included in Appendix A.

2.1.4 Climate

The climate of the area is representative of northern Illinois. Climatological (temperature and precipitation) data for the region is presented in Table 1. The data is measured in Dixon, Illinois (approximately 15 miles northeast of the landfill) and is maintained by the National Weather Service.

Data pertaining to wind direction and velocity have been incorporated into a wind rose on Plate 2.1.

Data for the period from 1980 to 1990 indicate an average maximum annual frost penetration depth of 20 inches; with the maximum frost penetration depth recorded during this time period being 30 inches. The data is obtained by the University of Illinois Climatology Department.

2.2 Site History

2.2.1 Prior Use

In 1963, the previous owners of the site, Armour and Company (Armour), constructed five wastewater ponds at the current landfill site. The ponds were used to treat liquid wastes from Armour's beef slaughter house. The ponds were formed by constructing earthen berms around their perimeters. It appears that only a limited amount (less than 10 feet) of soil was excavated from the bottom of the ponds. Historical documents indicate that the wastewater ponds were lined with clay. Although the as-built liner details are not well documented, the liner construction specifications and a subsequent estimation of the liner permeability are presented in Appendix B.

2.2.2 Initial Sludge Landfilling

NSW acquired the landfill site from Armour in the 1970s. After draining the ponds, reinforcing the existing liner and constructing access roads, NSW began placing PC sludge and pickle liquor sludge in two of the former ponds (Cells A and B, Plate 2.1) in October 1980.

2.2.3 Groundwater Monitoring

NSW maintains a groundwater monitoring program. At the present time, a system of ten groundwater monitoring wells (G121 through G130) is utilized, as shown in Plate 2.1.

The groundwater monitoring program consists of collecting and analyzing groundwater samples from the ten monitoring wells on a quarterly basis. The sample collection and analyses are conducted by an independent laboratory. The following parameters are analyzed on a quarterly basis:

- pH
- Specific Conductance
- Lead
- Cadmium

Additional analyses are conducted on an annual basis, at which time the following parameters are monitored:

- Chromium (hexavalent)
- Iron
- Manganese
- Zinc
- Sulfate
- Total organic carbon (TOC)
- Total organic halogens (TOX)

Upon receipt of data, all analytical data is entered into a computerized data base by NSW's consultant. Statistical analyses are performed on the data in accordance with the Part B permit to determine whether a statistically significant increase in any parameter has occurred.

The results of the analytical work and the statistical analyses are provided to the Illinois Environmental Protection Agency (IEPA) in accordance with the reporting requirements of the Part B permit. At no time during the monitoring program have the levels of the monitored constituents exceeded regulatory limits.

2.3 Description of Waste

2.3.1 Waste Generation and Volume

NSW produces steel from scrap through the use of three electric arc furnaces. Electric arc furnace pollution control sludge is a waste by-product from wet scrubbers which control particulate emissions from the furnaces. The waste is processed through vacuum filters which dewater the sludge, thereby allowing it to be handled more efficiently. The sludge is produced continuously during the steel manufacturing process, which occurs 24 hours per day, 7 days per week, 52 weeks per year. As the waste is produced, it is placed into a hopper. Once the hopper is filled, the waste is loaded onto dump trucks and transported to the stabilization facility adjacent to the landfill. The volume of waste generated depends upon the amount of steel produced, varies from approximately 2500 to 4000 tons per month, and averages approximately 35,000 tons per year.

2.3.2 Applicable Regulations and Waste Classification

The handling of the PC sludge and operation of the landfill is regulated under the Resource Conservation and Recovery Act (RCRA). Included in the regulations under RCRA are treatment standards, disposal practices, facility maintenance, monitoring procedures, and reporting requirements. A Part A application for interim operating status for the landfill was submitted in November of 1980. In 1987, the NSW Part B permit was approved. Additional regulations include National Pollutant Discharge Elimination System (NPDES) regulations for storm-water run-off, and Occupational Safety and Health Administration (OSHA) health and safety guidelines.

PC sludge is presently designated as K061 waste. Of the four characteristics which define a hazardous waste under RCRA (toxicity, corrosivity, ignitability, and reactivity), only the toxicity characteristic of the unstabilized PC sludge waste exceeds current United States Environmental Protection Agency (USEPA) standards.

In May of 1986, the K061 waste was included as one of the "first-third" wastes regulated under the land disposal regulations. Additional regulations required that the K061 be chemically treated (stabilized) prior to land disposal. To comply with these regulations, a stabilization facility dedicated to the treatment of NSW's PC sludge was built on-site. The facility is independently owned and operated by Conversion Systems, Inc. (CSI).

2.3.3 Waste Hauling, Stabilization and Placement

The PC sludge is trucked from the vacuum filters at NSW's West Plant Pollution Control Facility (WPPC) to the stabilization facility where it is treated to BDAT (best demonstrated available technology) standards. Applicable BDAT standards are presented in Table 2.

At the stabilization facility, the additives used in the process are weighed and fed into a batch mixer. The PC sludge is then weighed in proportion to the additives and fed into the mixer. The components are blended in the mixer and then discharged in approximately 20-ton batches into plastic-lined roll-off boxes. The stabilized waste is held in the roll-off boxes until laboratory analyses indicate that the waste is acceptable for landfilling. The laboratory analyses include the Paint Filter test (EPA Method 9095) and Toxicity Characteristics Leaching Procedure (TCLP) testing for cadmium, chromium, lead, and nickel to ensure compliance with the BDAT requirements. If the metals concentration of the processed waste exceeds the regulatory limits, or the waste does not pass the Paint Filter test, the waste is reprocessed at the facility. The Paint Filter test requirement ensures no liquid wastes are placed in the landfill.

After laboratory results indicate that the waste has been successfully stabilized, the roll-off boxes are moved along a track system. At the end of the tracks, the roll-off boxes are placed and secured on a lugger truck, and transported to the landfill. Once at the landfill, the truck drivers will back the trucks onto waste unloading pads, disengage the roll-off box tailgate and incline the roll-off box, thereby allowing the waste to slide out of the roll-off box onto the landfill surface below. The waste will then be placed and compacted by dedicated landfill equipment. Details of waste handling and placement are included in the Landfill Operations Manual.

2.3.4 Landfilled Waste Characteristics

Stabilized PC sludge contains elevated levels of metals, and a pH of approximately 9 to 10.5. TCLP tests for cadmium, chromium, lead, and nickel and the Paint Filter tests are routinely performed by CSI on the stabilized waste as part of the regulatory requirements prior to landfilling.

Physical characteristics of the stabilized PC sludge were investigated during the geotechnical investigation and are described in Appendix A.

3.0 LANDFILL EXPANSION DESIGN APPROACH

The landfill will be expanded vertically, no lateral expansion will occur. This vertical expansion is exempt from the liner and leachate detection system requirements of 35 IAC 724.401. The vertical expansion will be accomplished by constructing berms of compacted earth fill, and placing the waste within the berms. Details of the design are presented in Section 4.

3.1 Berms

The berms will be constructed in approximately 10-foot high lifts. Berm construction will be phased over the life of the landfill. Initially, an approximately 10-foot high berm will be constructed around the perimeter of Cells A and B. A limited amount of existing waste contained within these cells will be regraded, and new waste will be placed to near the elevation of the top of the berms. Once this is accomplished, another 10-foot high berm will be placed around the perimeter of Cell A and waste will be placed within this berm. When the waste in Cell A approaches the level of the top of the berm, another berm will be constructed around Cell B and waste will be placed within that berm. This procedure of alternatively constructing berms and placing waste within Cells A and B will continue until the landfill has reached its design capacity, at which time the landfill will undergo closure activities. Five 10-foot high lifts are planned, which would result in the top of the completed landfill at or below Elevation 700 feet MSL. Plates 3.1 through 3.9 illustrate the berm construction sequence.

The estimated waste capacity of each phase, and estimated dates of operation within each phase are presented in Table 3. The actual landfill capacity and operational life will be dependent upon a number of factors, including waste production, waste characteristics and waste handling procedures. The Landfill Operations Manual is directed to maximize the capacity and life of the landfill while assuring proper environmental controls.

3.2 Surface Water Management

Surface water which falls onto the waste will be directed toward low points constructed within the landfill interior. The low points are sized to retain 150 percent of the surface water run-off from the 25-year storm. The low points will be maintained with a reserve capacity equal to at least 100 percent of the run-off from the 25-year storm. Drainage from the low points will be controlled by valved outlet works. Prior to discharge, a sample of the run-off water will be analyzed for metals. If, as expected based upon laboratory tests performed during this investigation, the metals in the water are below hazardous levels, the water will then be discharged to Cell C. Water stored in Cell C will be used for dust control and process water at the stabilization facility as needed. If the levels are above hazardous levels, then the water will be treated to below BDAT standards and discharged to Cell C.

Surface water run-on is not a concern since the waste will be retained within berms. Precipitation which falls on the crest and exterior of the berms will be directed away from the landfill. In addition, the landfill is located above the 500-year flood level of the Rock River; therefore, inundation by flood waters is extremely unlikely.

4.0 BASIS OF DESIGN

4.1 Regulatory Basis

The design is based upon the provisions contained in Chapter 35 of the Illinois Administrative Code Subpart N: Landfills. Specifically, the landfill is designed with no new liner or leachate detection system on the basis that no lateral expansion will occur.

4.2 Technical Basis

4.2.1 Berms

4.2.1.1 Construction Details

The perimeter berms will be constructed of compacted fill. In general, the berms will be 50 feet wide at their base and 15-feet wide at their crest. The exterior slope face will be constructed at a 2:1 (horizontal to vertical) gradient and, except for the Phase I (bottom) berm, the interior (temporary) slope face will be constructed at a 1.5:1 gradient. The Phase I berm interior slope face will be constructed at a 2:1 gradient.

Phase I berm construction is estimated to require 70,000 cubic yards of fill materials. The fill materials will be derived from the open land northeast of the landfill. The planned borrow area is shown on Plate 4.1. Fill will be placed in lifts less than 8-inches thick (loose thickness), moisture conditioned to near optimum moisture content and compacted to at least 90 percent relative compaction¹. The Phase I berm will be keyed at least 3 feet into firm foundation soils as illustrated on Plate 4.2. The berm will not be founded on weak fill, such as that encountered near the southwest corner of Cell A. Rather, these materials will be excavated and recompacted.

¹ Relative compaction refers to the ratio of the in-place dry density of fill material to the maximum dry density of the same material as determined by the ASTM D1557 (Modified Proctor) test procedure.

Fill slopes will be overfilled, compaction effort will be extended to the edge of the overfilled slopes, and the slopes will then be cut back to grade to expose a well-compacted slope face.

To minimize erosion of the berm slope face, drainage benches will be constructed on the exterior slope face at 20-foot vertical increments. Intercepted water will be directed to the base of the berm via protected drainage channels. As an additional precaution against erosion, the exterior slope face will be planted with grass upon completion of each phase of berm construction.

Access to the top of the berm will be provided by a 15-foot wide road constructed along the northern flank of Cell A as illustrated on Plate 3.1. The road will have a 7.5 percent grade and merge with the access road constructed along the top of the berms. The access roadbase will consist of 12-inches of slag aggregate over compacted subgrade.

The waste will be unloaded at specially constructed waste unloading pads illustrated on Plate 4.3. The truck will back onto the waste unloading pads to near the top of the slope. The truck driver will then unlatch the tailgate and dump the waste onto the landfill surface below. Wheel stops will be placed on the pads to help the truck driver identify how far to back the truck. The outer 15 feet of the waste unloading pads will be constructed of compacted slag aggregate to provide a firm base for the trucks.

4.2.1.2 Stability Analyses

The stability of the berm was evaluated using the computer program PCSTABL5M, developed at Purdue University. Total stress analyses were conducted using the simplified Janbu method of analysis. The following load cases were modelled and analyzed:

- The overall (static and seismic [$a = 0.05g$]) stability of the berm upon completion,
- Stability of the upper portions of the interior and exterior berm slope including wheel loads from the loaded waste hauling truck on the berm access road, and

- Stability of the waste unloading pad including wheel loads from the waste hauling truck.

The results of the stability analyses, along with minimum factors of safety judged to be appropriate for the various loading conditions are summarized in Table 4. The input data and computer output, including plots of the analyzed cross-sections and the 10 most-critical slip circles are attached in Appendix C.

Geotechnical parameters used for the slope stability calculations were based upon the field and laboratory test data collected during HLA's geotechnical investigation (Appendix A). Residual, saturated shear strength values were used for conservatism and strain-compatibility. For further conservatism, the waste material shear strength values corresponding to the laboratory test results for samples remolded to 85 percent relative compaction were used. Actual waste material compaction and thus strengths are expected to be higher in the field. Geotechnical parameters for compacted fill and slag aggregate were assumed based upon engineering judgement. The geotechnical parameters used are summarized in Table C1 in Appendix C.

4.2.2 Surface Water Run-Off Management

4.2.2.1 Internal Run-Off

The design will direct surface water which falls on the landfill interior toward the low points. Surface water will flow by gravity toward the low points except immediately after the construction of the Phase I berm at which time the surface of the waste material near the interior base of the berm will be sloped toward the base of the berm. The first phase of waste placement will be directed to achieving site grades so that this area drains by gravity toward the low points. Until this is achieved, surface water which drains away from the low points will be pumped into the low points after each storm.

The low points are designed to retain 150 percent of the run-off expected from the 25-year, 24-hour storm event. As stated in the Part B permit application, this event is estimated to consist of 5-inches of rainfall. For design purposes, because the waste surface will be compacted and thus relatively impermeable, it is assumed that no infiltration will occur and thus run-off will equal the precipitation over the watershed area. Run-off calculations and volumes, and the low point capacities for the different landfill phases are summarized in Table 5.

The low points will be constructed with 2.5:1 side slopes. Ultraviolet (UV)-stabilized 30-mil PVC sheeting will be placed on the sides and bottoms of the low points to separate surface water run-off from the landfilled waste. This is expected to have several advantages over unprotected low points, including improved quality of the discharged water, improved stability of the low point sides and improved foundation for future lifts.

Water will be discharged from the low points via buried 12-inch diameter ductile iron discharge pipes. The discharge pipes will be cement-lined to provide corrosion protection, and encased in polyethylene to minimize the amount of soil loads on the pipe as the landfill settles. Push-on joints will be used on the lateral portions of the pipe to improve flexibility as the landfill settles. Flanged-joints will be used on the vertical portions of the pipe. Thrust blocks will be constructed at the pipe elbows to resist downward loads.

Inlets to the discharge pipes will consist of vertical extensions of the discharge pipes rising 2 feet above the base of the low points. The inlets will be belled to 18-inches diameter to facilitate water flow into the discharge pipe. In addition, the inlets will be screened to prevent the introduction of large obstructions into the discharge pipes. The discharge pipes will slope downward toward the outfalls at Cell C and, except for the first phase in Cell B, water will be discharged by gravity. Discharge will be controlled by valves near the outfalls. The valves will be buried to prevent freezing and will remain closed and locked except during discharge. Water sampling ports will be constructed just upgradient of the discharge valves. The water sampling ports will be closed and locked except during sample collection and discharge events. A schematic of the discharge pipe valving is presented in Plate 4.4.

Upon initiation of construction, waste in Cell B is estimated to be near Elevation 645, only 7 feet above the level of the low point discharge pipe outlet. As a result, site grades will prevent gravity discharge of water from the Phase I internal low point in Cell B. Therefore, during Phase I, water which collects in the Cell B internal low points will drain into a sump constructed adjacent to the discharge pipe inlet, and the water will be pumped from the sump into the discharge pipe. A centrifugal pump will be used for this purpose. The sump will consist of 4-inch diameter, schedule 40 PVC blank pipe.

A graduated staff will be mounted vertically in the low point to allow direct measurement of the water level in the low points. The water levels in the low points will be managed to retain a reserve capacity equal to at least 100 percent of the run-off from the design storm.

The low points corresponding to the various landfill phases are shown on Plates 3.1 through 3.9. Schematic cross-sections of the low point and discharge pipe at Cell B for both the initial and final phases of landfilling are presented on Plate 4.5.

Laboratory tests conducted during HLA's geotechnical investigation (Appendix A) suggest that the quality of run-off which will flow into the low points will meet RCRA requirements for discharge into Cell C. To confirm this, water samples will be collected from the low points and analyzed for total concentrations of cadmium, chromium, lead, and nickel prior to each discharge during the initial year of operation. After one year of operation, water samples will be collected on a quarterly basis.

Although unexpected, it is possible that water retained in the low points could contain concentrations of metals exceeding RCRA limits. If this occurs, IEPA will be notified and a portable water treatment system will be mobilized to the site as soon as practical. Although the type of any required treatment cannot be specified until the actual water quality results are available, it is anticipated that it could include pH adjustment, clarification and/or filtration. Treated water would contain levels of cadmium, chromium, lead, and nickel below BDAT standards prior to discharge into Cell C.

The operational procedures for the sampling and discharge of water from the low points are detailed in the Landfill Operations Manual.

4.2.2.2 External Run-Off

Precipitation which falls on the berm access road, waste unloading pads and the exterior berm slope face will flow down the berm, away from the landfilled waste. In general, surface water which will run-off the berms will sheet-flow away from the toes of the berms. However, to facilitate compliance with future NPDES stormwater run-off monitoring and to improve drainage outside the landfill perimeter, drainage swales will be constructed around a portion of the berm perimeter. Surface water which is intercepted by a drainage bench on the exterior berm slope face will be directed to the base of the berm and flow into the drainage swales at the toe of the berm or directly into Cell C. Drainage system schematics are presented on Plates 3.1 through 3.9.

4.2.3 Surface Water Run-On

The landfill is located above the 500-year flood plain of the Rock River; therefore, inundation by flood waters is not a concern.

4.2.4 Settlement

The stabilized waste is not biodegradable and thus settlement will be limited to that caused by consolidation due to the weight of the landfilled material. Based upon calculations using the geotechnical data collected during HLA's investigation, it is estimated that the maximum settlement will be less than 24-inches. Because this expected settlement is load-related, and the induced loads will be relatively uniform, the settlement profile across the landfill is expected to be relatively smooth. In addition, the settlement will essentially be non-observable because it will occur as, or shortly after, each lift of waste is applied. Because of this, it is estimated that negligible (less than 4-inches) of settlement will occur after closure. Settlement calculations are presented in Appendix D.

4.2.5 Groundwater Monitoring Wells

The Phase I berm in the southern portion of Cell A will encroach over existing groundwater monitoring wells G-129 and G-130. To protect these wells, prior to berm construction, the well casings will be extended vertically to above the level of the future berm slope. At each well, an 18-inch diameter corrugated metal pipe (CMP) will then be placed and centered around the wellhead, and a 6-inch diameter concrete form will be placed within the annular space between the well casing and CMP protective casing. Concrete will be placed in the annular space between the formwork and CMP. When the berm construction has been completed, the annular space between the 6-inch form and the well casing will be sealed with concrete or grout. Details of the wellhead protection technique are shown on Plate 4.6. If damaged during construction, the wellheads will either be repaired, or the wells will be properly abandoned and new wells will be constructed.

4.2.6 Construction Sequence

The first phase of construction will include the following:

- Phase I berm around both Cells A and B;
- Surface water drainage swales and catch basins at the toe of the berm;
- Internal low points, discharge pipes and outfalls for both Cells A and B; and
- Landfill perimeter access road.

When a cell is nearing capacity, the berm around the inactive cell will be raised. The low point in the just-filled cell will be filled with compacted stabilized waste and a new low point will be constructed. Waste placement will then be directed to the next cell.

Low point construction will consist of the following activities:

- Construct a temporary berm with stabilized waste material around the perimeter of the low point to prevent surface water from flowing into the low point. Any water which collects behind the temporary berm will be pumped into the discharge pipe upon confirmation of the water quality.
- Drain the low point and remove all sediments. The sediments will be tested using the TCLP and either placed on the landfill (if BDAT requirements are met) or processed at the stabilization facility,
- Raise the discharge pipe by adding an extension to achieve the desired inlet elevation,
- Fill the former low point and the sides of the new low point with compacted stabilized waste to the level of the new low point,
- Place the UV-stabilized PVC separation layer on the bottom and sides of the low point, and
- Remove temporary berm.

This construction sequence is illustrated on Plate 4.7.

4.2.7 Construction Quality Control

All construction activities will be performed under the observation and testing of a Registered Professional Engineer. Specifically, the following construction details will be checked:

- Site grades;
- Fill placement and compaction;
- Placement and grading of discharge pipes and valves; and
- Placement and seaming of the PVC sheeting.

A Construction Quality Assurance (CQA) Manual will be prepared in substantial accordance with EPA Technical Guidance Document No. 530-SW-86-031. The CQA Manual will provide the basis for construction quality control.

TABLES

TABLE 1

MEAN MONTHLY TEMPERATURES AND PRECIPITATION
FOR THE STERLING, ILLINOIS AREA

Month	Mean Temperatures (°F)		Precipitation (inches)
January	28.0	9.8	1.37
February	33.1	14.6	1.11
March	45.7	27.0	2.51
April	60.7	38.3	3.51
May	72.6	48.8	3.98
June	82.0	58.1	4.48
July	85.2	62.7	3.63
August	83.1	59.9	3.97
September	75.7	50.9	3.67
October	63.8	40.5	2.69
November	47.9	29.8	2.50
December	32.7	17.1	2.05

Note: Data from National Climatic Data Center meteorological monitoring station No. 11-23-48, Dixon One Northwest, in Dixon, Illinois.

TABLE 2

APPLICABLE BDAT STANDARDS

CONSTITUENT	BDAT STANDARD (milligrams/liter)
Cadmium	1.61
Chromium	0.32
Nickel	0.44
Lead	0.51

NOTE: BDAT Standards based upon results of Toxicity Characteristics Leaching Procedure (TCLP) test protocols.

TABLE 3
ESTIMATED CAPACITY OF EACH PHASE

PHASE	ESTIMATED CAPACITY		ESTIMATED LIFE OF PHASE
	CUBIC YARDS	TONS	
I-A/B	41,000	77,000	4-92 to 11-93
II-A	62,000	115,000	11-93 to 4-96
II-B	70,000	130,000	4-96 to 11-98
III-A	48,000	86,000	11-98 to 7-00
III-B	55,000	101,000	7-00 to 2-03
IV-A	38,000	67,000	2-03 to 7-04
IV-B	44,000	82,000	7-04 to 8-05
V-A	26,000	48,000	8-05 to 9-06
V-B	31,000	58,000	9-06 to 3-08

NOTES:

1. Estimated capacity of stabilized waste based upon average in-place wet density = 128 pounds per cubic foot at 25 percent moisture content. Tonnage estimate refers to weight of stabilized PC sludge upon stabilization.
2. Estimated capacity refers to capacity remaining immediately after berm construction.
3. Estimated Phase Life based upon 35,000 tons per year of unstabilized waste bulking to 48,000 tons per year of stabilized waste.

TABLE 4

SLOPE STABILITY ANALYSES SUMMARY

LOAD CASE	FACTOR OF SAFETY	
	Calculated Minimum	Minimum Acceptable
Overall Berm Stability		
Static	1.6	1.5
Seismic	1.4	1.1
Berm Access Road w/Truck Surcharge		
Exterior Slope	1.4	1.25
Interior Slope	1.3	1.25
Waste Unloading Pad w/Truck Surcharge	1.4	1.25

NOTES:

1. Stability analyses performed using PCSTABL5M (simplified Janbu method of analysis).
2. Input data and computer-generated output, including plots of the sections analyzed and 10 most-critical slip circles, are presented in Appendix C.
3. Minimum acceptable factors of safety:
 - 1.5 : Static, long-term loads
 - 1.25: Repeated transient loads
 - 1.1 : Non-repeating transient loads

TABLE 5

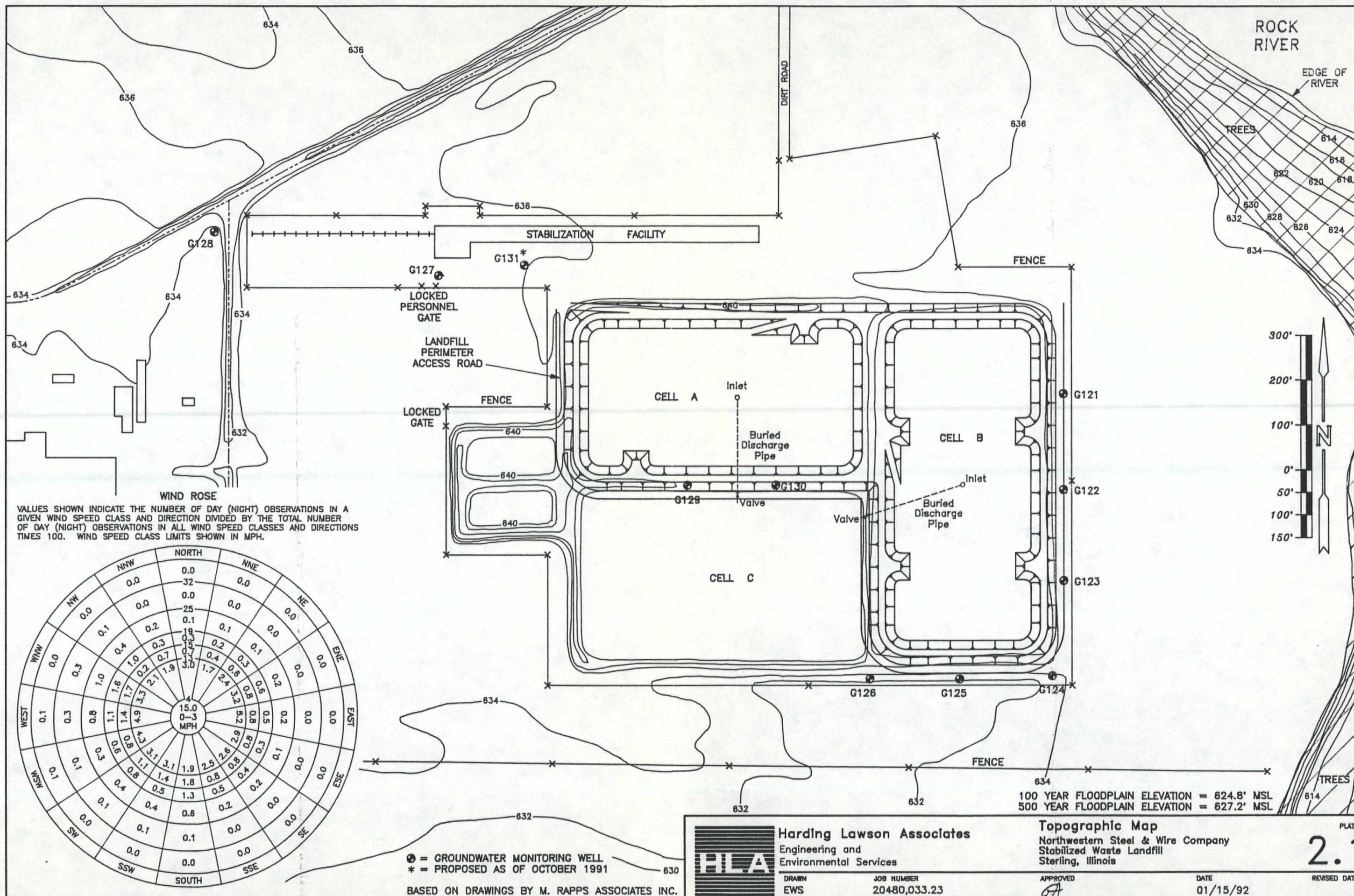
LOW POINT DESIGN CAPACITIES

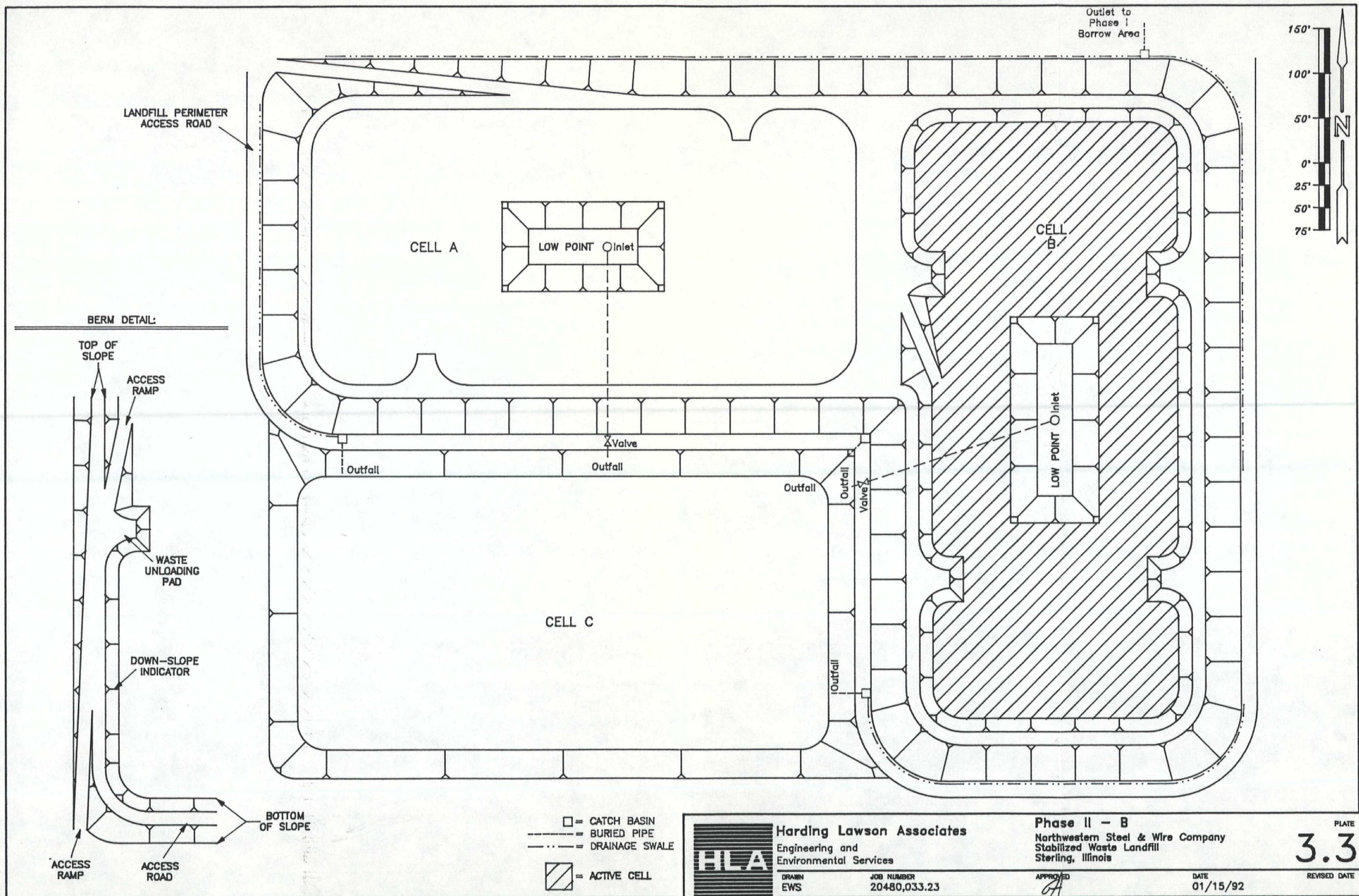
CELL	PHASE	WATERSHED AREA (FT ²)	DESIGN RUN-OFF (FT ³)	MINIMUM LOW POINT CAPACITY (FT ³)
A	I	216,400	90,200	135,300
	II	184,800	77,000	115,500
	III	146,100	60,900	91,400
	IV	118,200	49,300	74,000
	V	84,300	35,200	52,800
B	I	246,900	102,900	154,400
	II	211,500	88,200	132,300
	III	167,900	70,000	105,000
	IV	137,100	57,200	85,800
	V	99,300	41,400	62,100

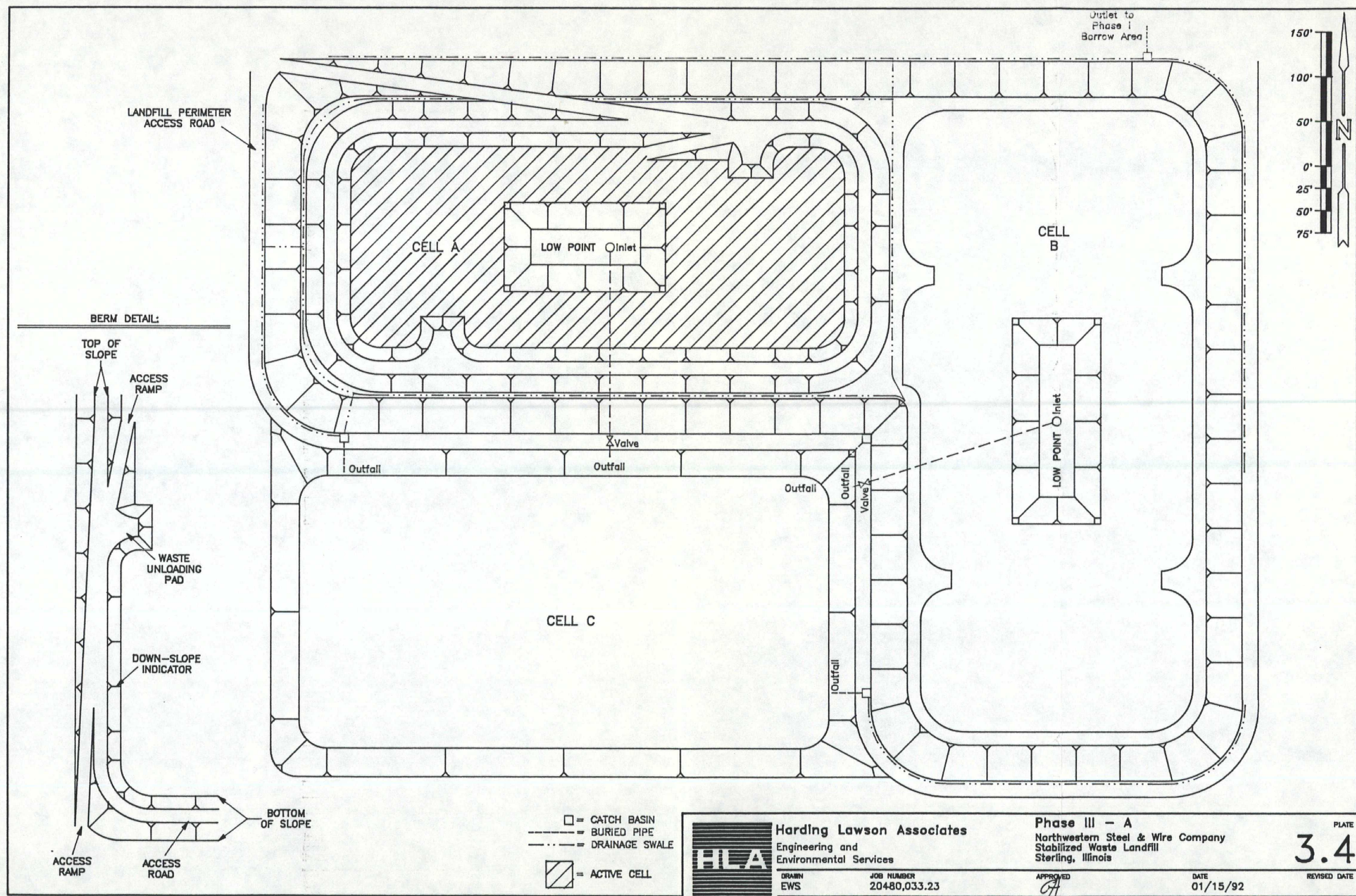
NOTES:

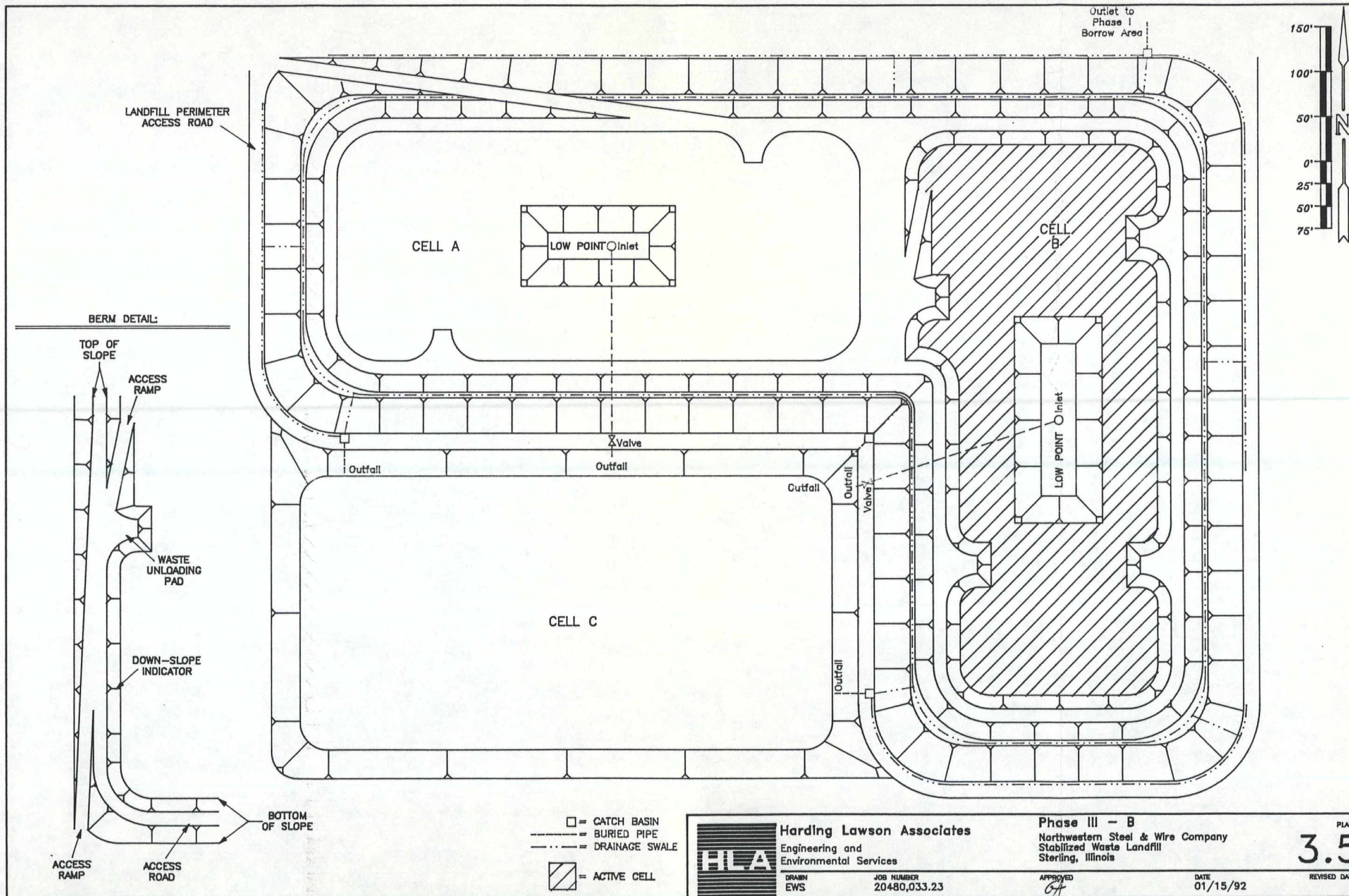
1. Watershed area consists of landfill interior.
2. Design run-off equals run-off expected from 25-year, 24-hour storm (5 inches of precipitation) assuming no infiltration.

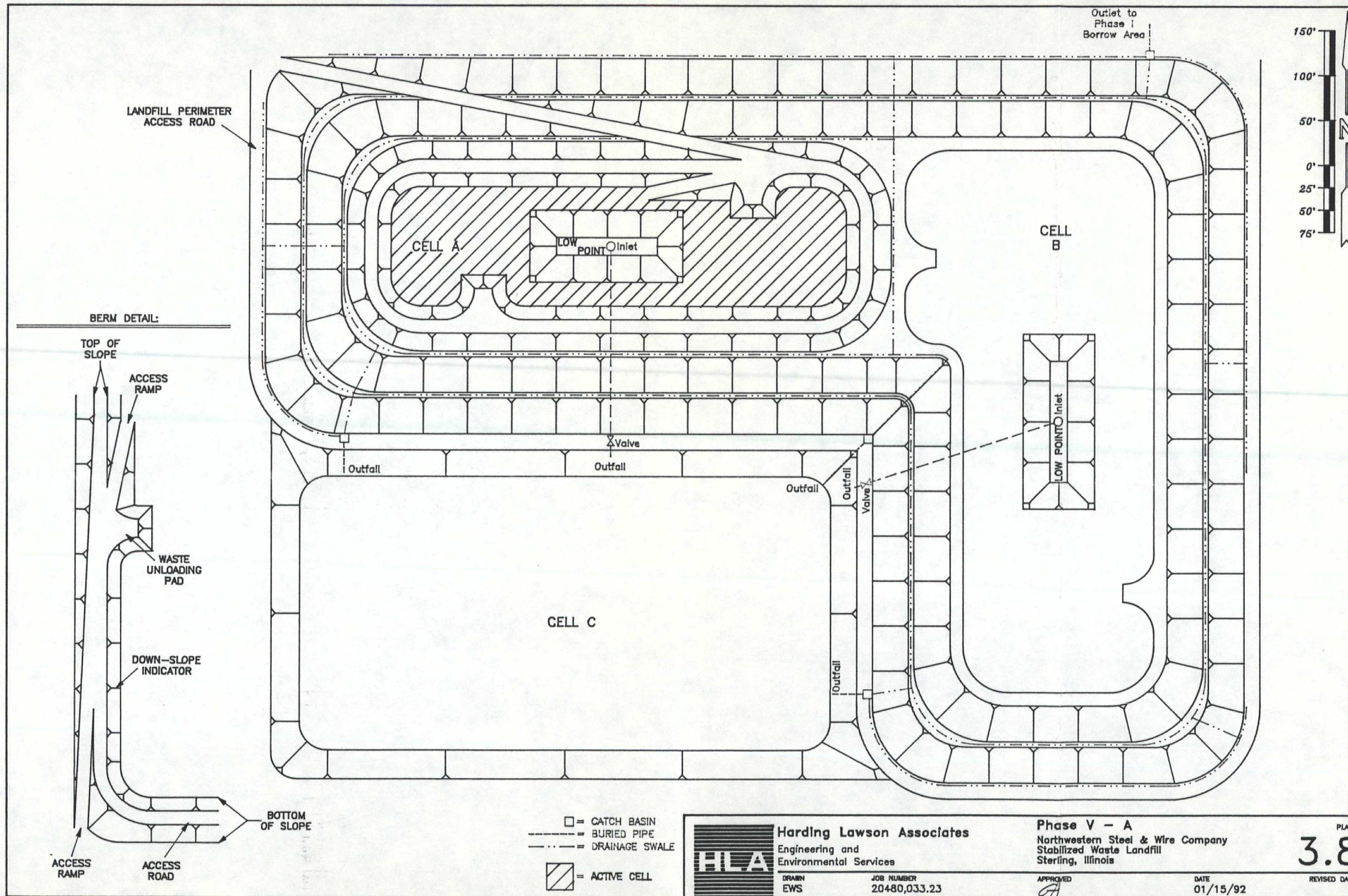
ILLUSTRATIONS

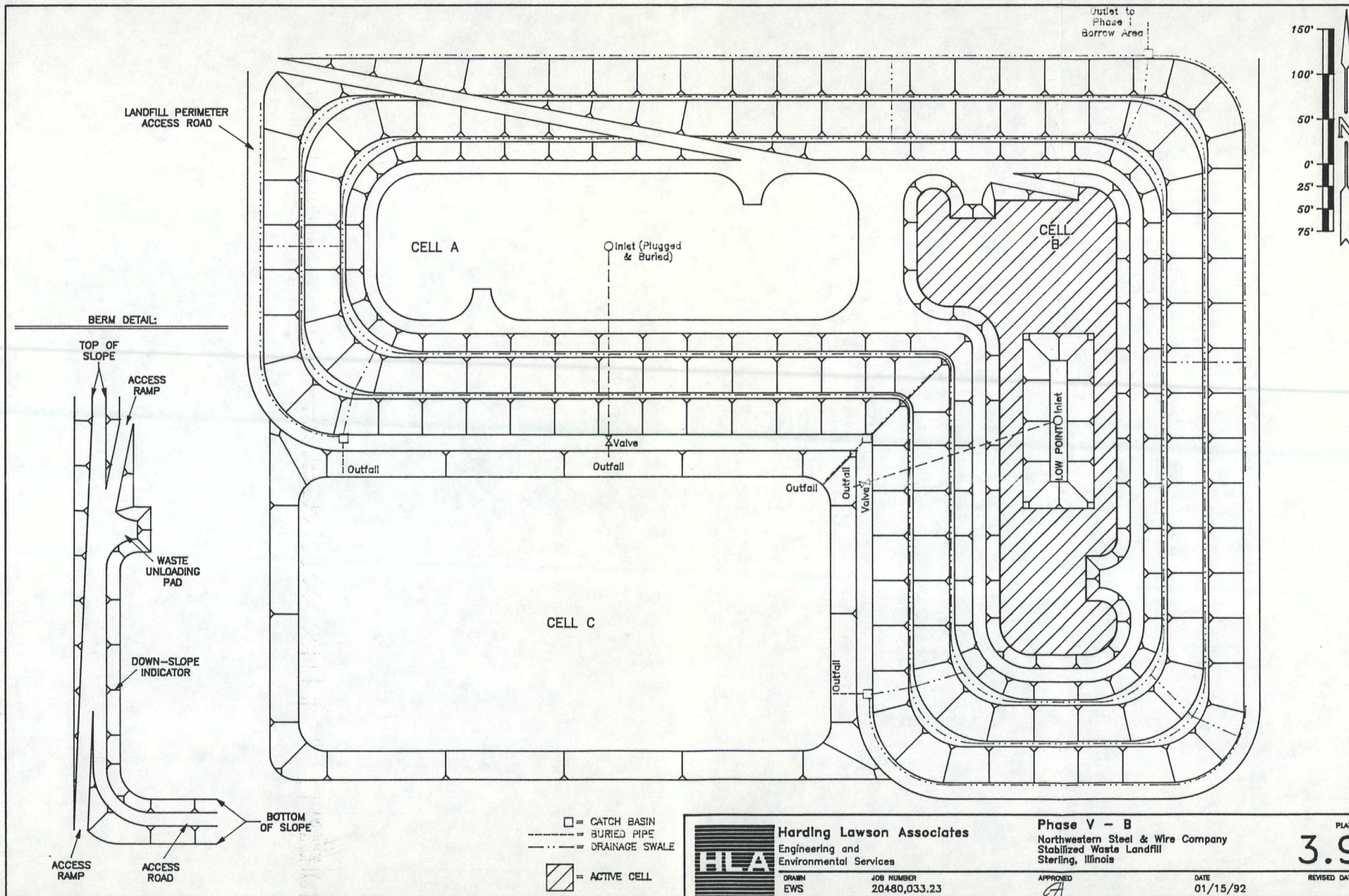


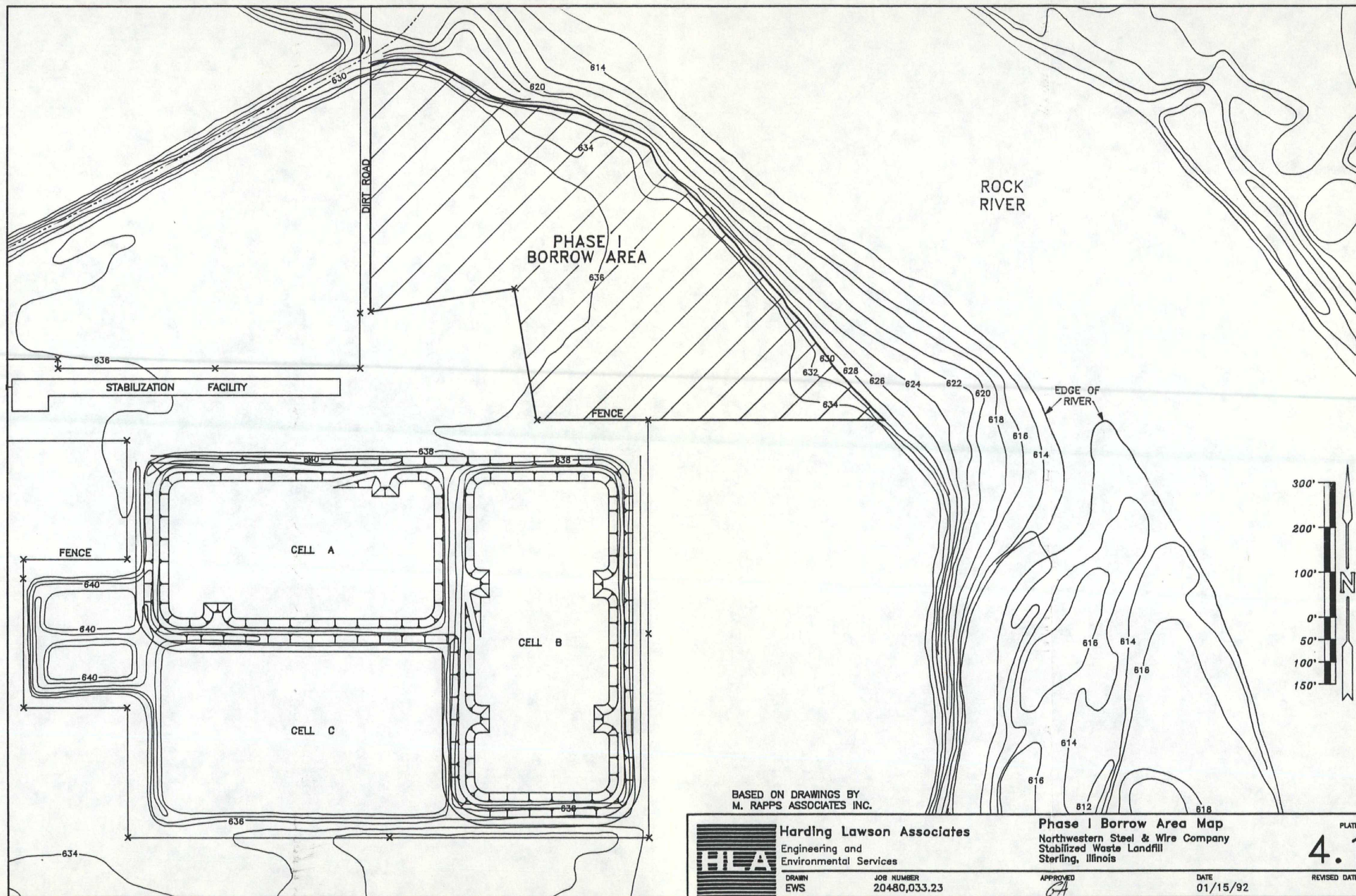












BASED ON DRAWINGS BY
M. RAPPS ASSOCIATES INC.



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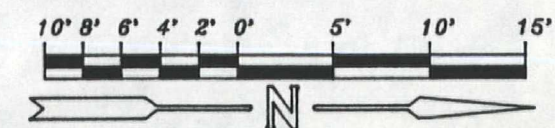
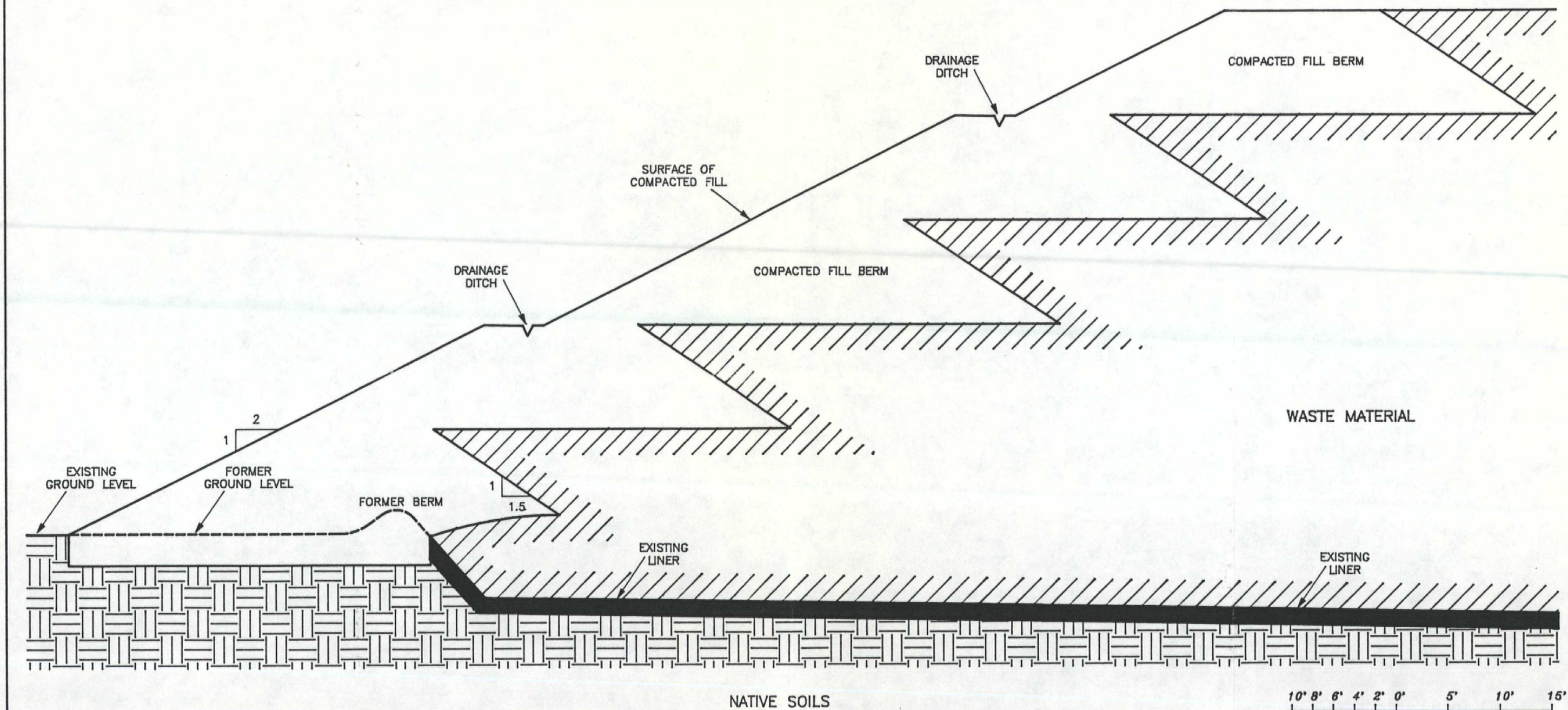
Phase I Borrow Area Map
Northwestern Steel & Wire Company
Stabilized Waste Landfill
Sterling, Illinois

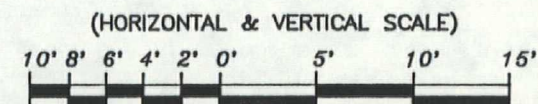
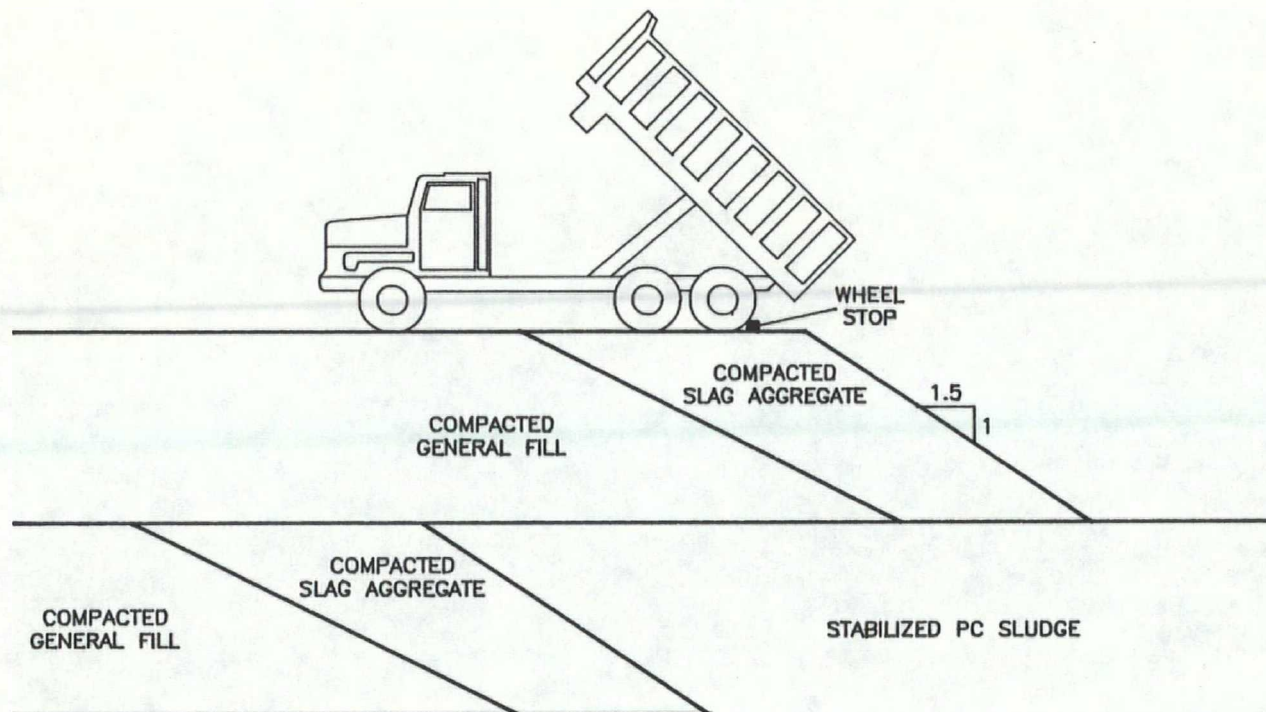
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4.1

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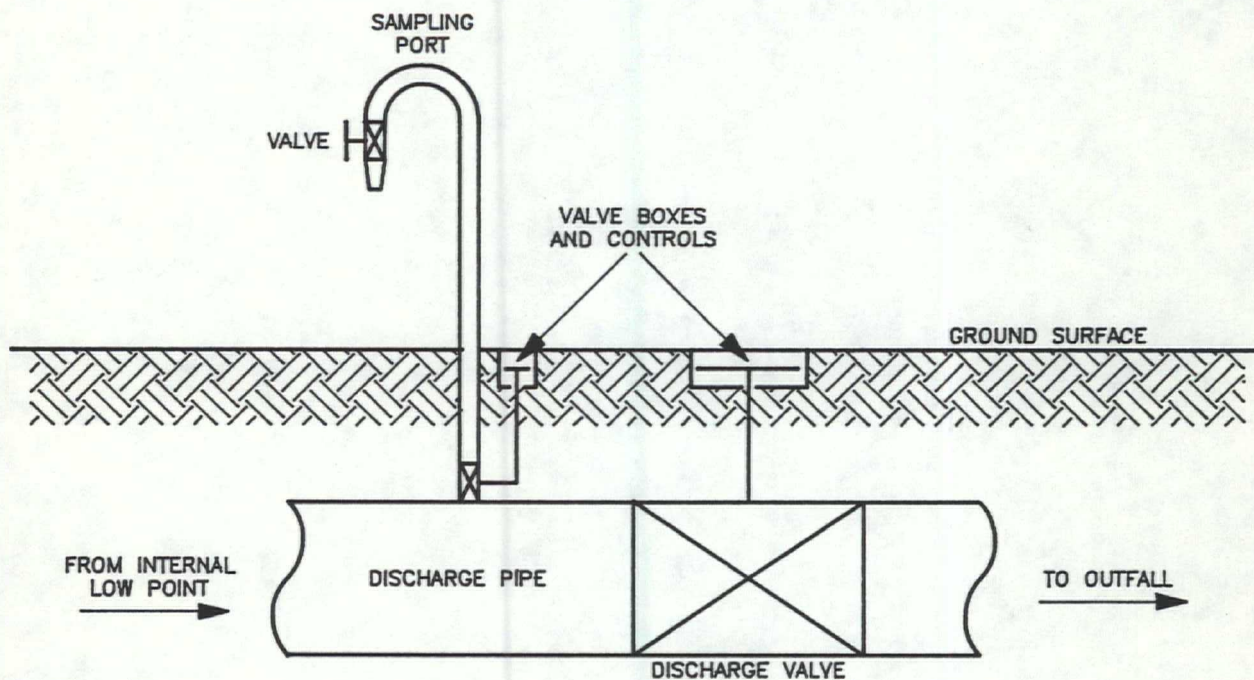
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Waste Unloading Pad Detail
Northwestern Steel & Wire Company
Stabilized Waste Landfill
Sterling, Illinois

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DATE
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4.3
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Discharge Pipe Valving Schematic
Northwestern Steel & Wire Company
Stabilized Waste Landfill
Sterling, Illinois

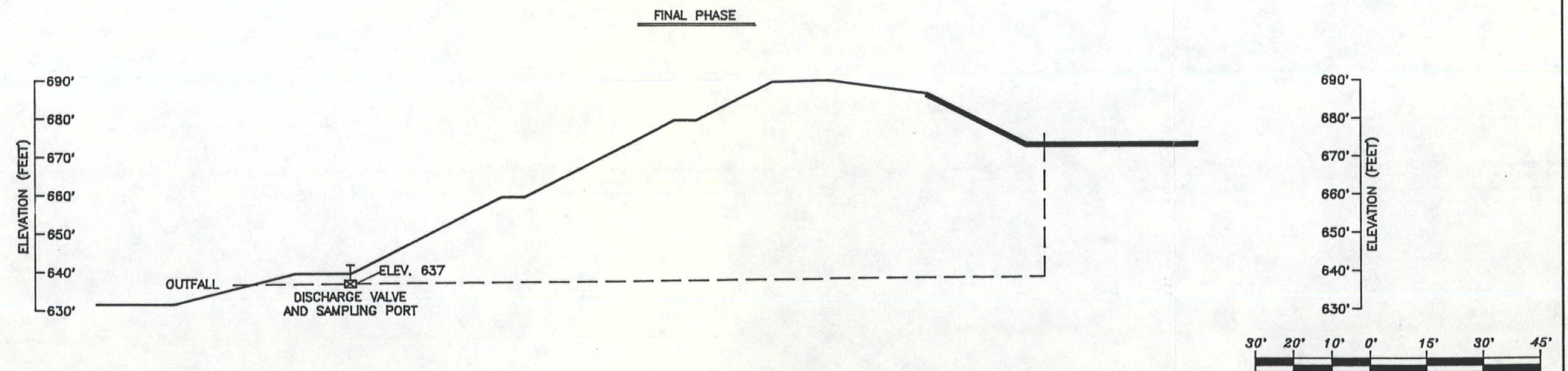
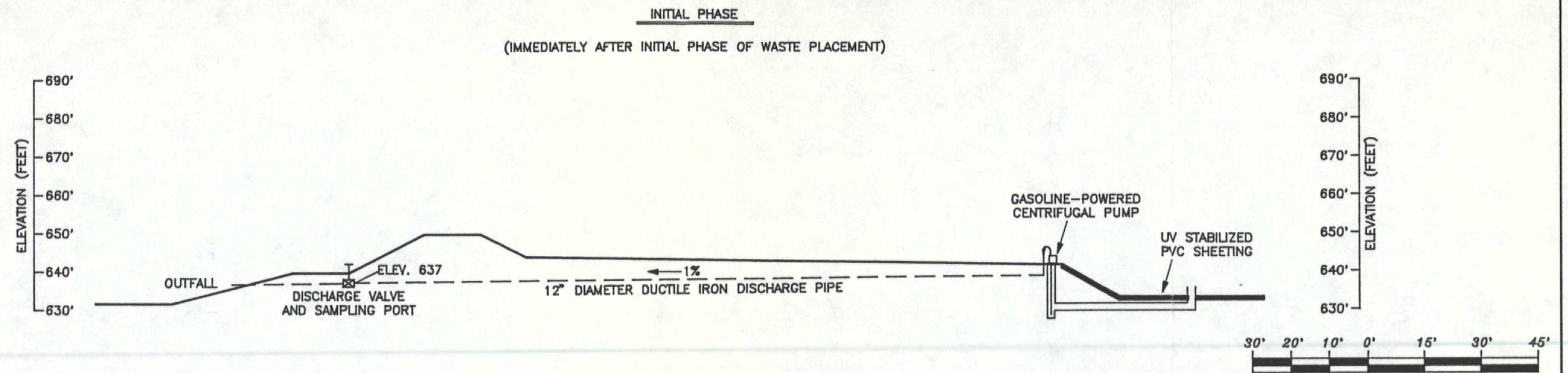
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PLATE

4.4



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Discharge Pipe Schematic
Northwestern Steel & Wire Company
Stabilized Waste Landfill
Sterling, Illinois

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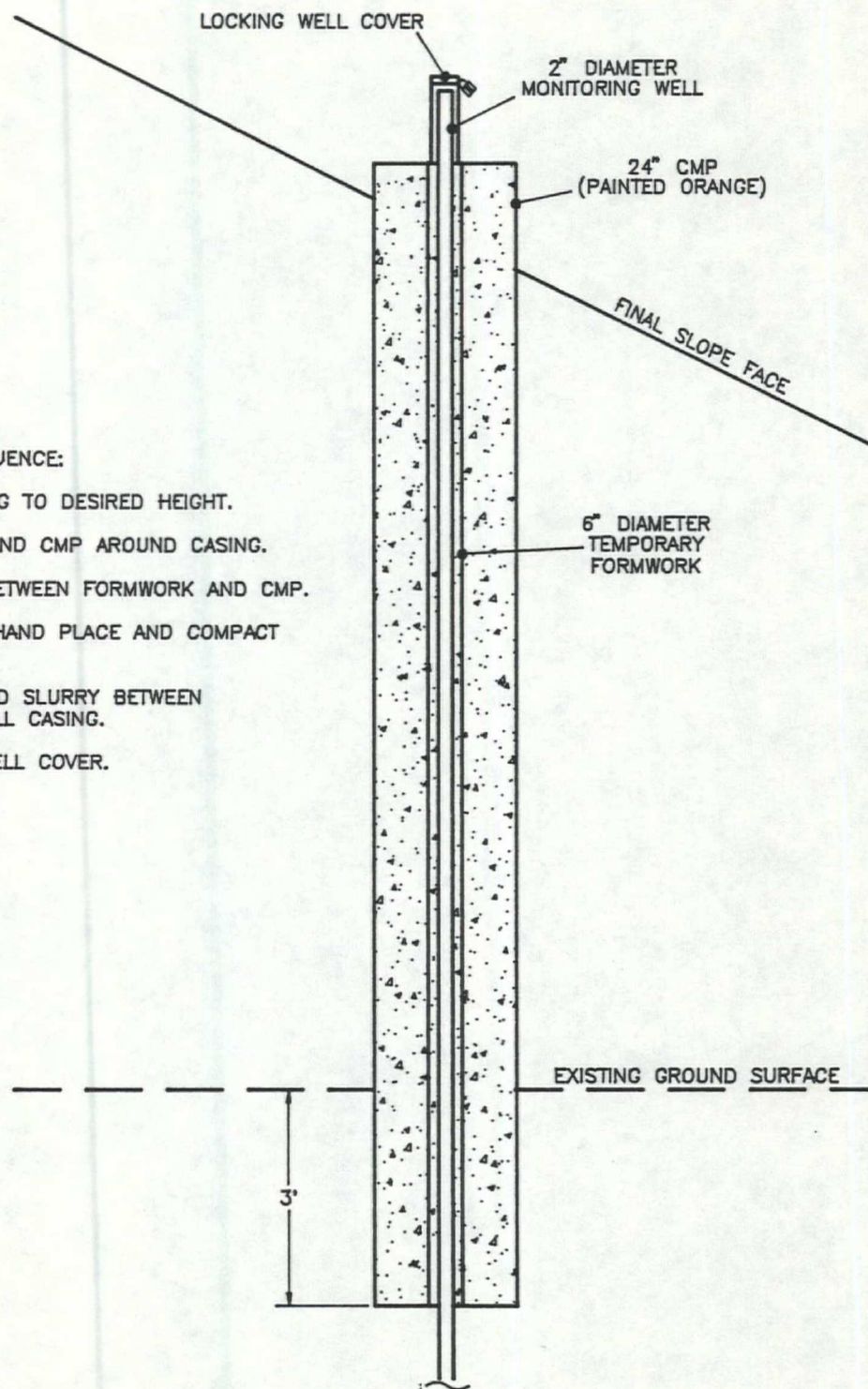
DATE
01/15/92

PLATE
4.5

REVISED DATE

WELL PROTECTION SEQUENCE:

1. EXTEND WELL CASING TO DESIRED HEIGHT.
2. PLACE FORMWORK AND CMP AROUND CASING.
3. PLACE CONCRETE BETWEEN FORMWORK AND CMP.
4. CONSTRUCT BERM, HAND PLACE AND COMPACT FILL AROUND WELL.
5. PLACE CEMENT-SAND SLURRY BETWEEN FORMWORK AND WELL CASING.
6. INSTALL LOCKING WELL COVER.



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Wellhead Protection Diagram
Northwestern Steel & Wire Company
Stabilized Waste Landfill
Sterling, Illinois

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A

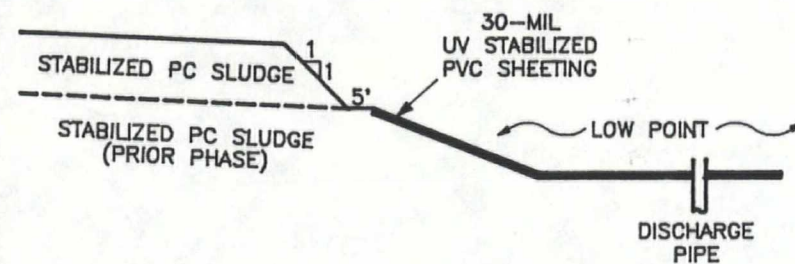
DATE
01/15/92

REVISED DATE

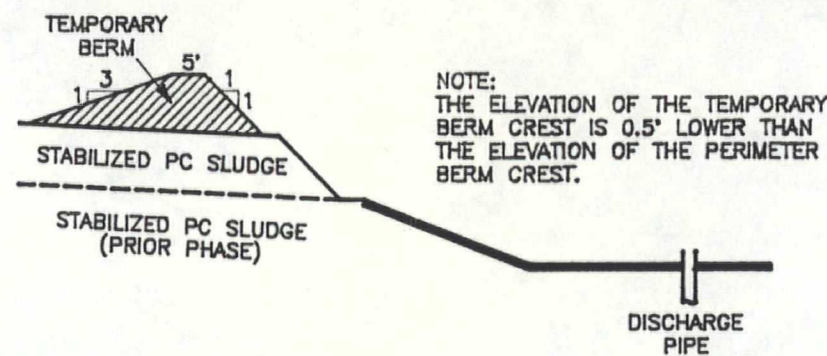
PLATE

4.6

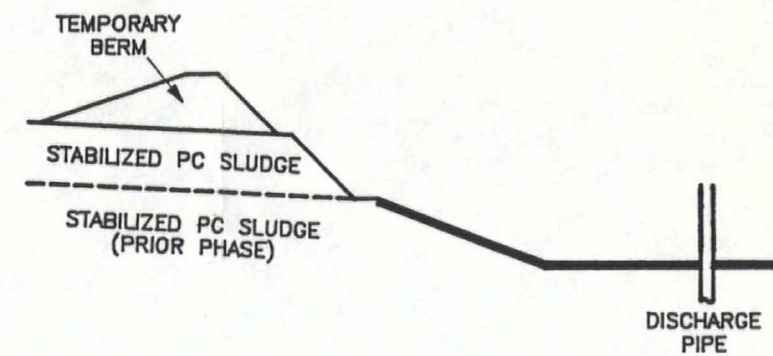
NEAR COMPLETION OF PHASE:



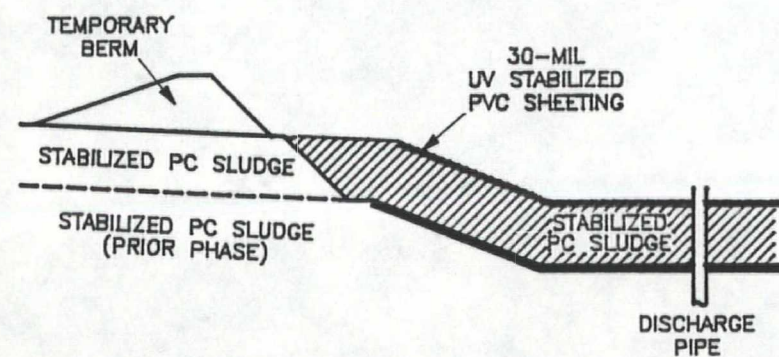
STEP 1:
CONSTRUCT TEMPORARY BERM



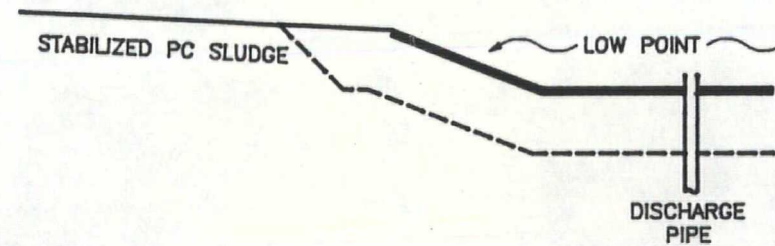
STEP 2:
EXTEND DISCHARGE PIPE INLET



STEP 3:
PLACE AND COMPACT STABILIZED PC
SLUDGE TO FORM NEW LOW POINT
AND INSTALL PVC SHEETING



STEP 4:
REMOVE TEMPORARY BERM



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Low Point Construction Sequence
Northwestern Steel & Wire Company
Stabilized Waste Landfill
Sterling, Illinois
















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DATE
01/15/92

PLATE
4.7
REVISED DATE

APPENDIX A

GEOTECHNICAL INVESTIGATION

MAJOR DIVISIONS					TYPICAL NAMES
COARSE-GRAINED SOILS MORE THAN HALF IS LARGER THAN No. 200 SIEVE	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN No. 4 SIEVE SIZE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW		WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES
			GP		POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES
		GRAVELS WITH OVER 12% FINES	GM		SILTY GRAVELS, POORLY GRADED GRAVEL-SAND-SILT MIXTURES
			GC		CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN No. 4 SIEVE SIZE	CLEAN SANDS WITH LITTLE OR NO FINES	SW		WELL-GRADED SANDS, GRAVELLY SANDS
			SP		POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 12% FINES	SM		SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES
			SC		CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES
FINE-GRAINED SOILS MORE THAN HALF IS SMALLER THAN No. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT 50% OR LESS	ML		INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY	
		CL		INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS	
		OL		ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50%	MH		INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS	
		CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
		OH		ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
HIGHLY ORGANIC SOILS			Pt		PEAT AND OTHER HIGHLY ORGANIC SOILS

- - "Undisturbed" S&H or Shelby tube sample
- ▨ - Bulk or classification sample
- ▩ - Standard Penetration Test sample
- ▧ - No sample recovered
- I - Core sample

Blows/ft - Blows required to drive sampler 12 inches with a 140-pound hammer falling 30 inches. Blow counts for S&H samplers are converted to approximate "equivalent" SPT N values (N = 0.5 X S&H blows per foot)

- 200 = % Finer No. 200 Sieve
- LL = Liquid Limit
- PI = Plasticity Index
- MA = Mechanical (grain-size) Analysis
- Consol = Consolidation
- 1-PL Consol = One Point Consolidation
- DSCD 750 (1000) = Direct Shear
 - Normal Stress (psf)
 - Peak Shear Strength (psf)
- TxUU-(S or FM) 1000 (1500) = Triaxial Shear, unconsolidated.
 - Confining Pressure (psf)
 - Peak Shear Strength (psf)
- S = Back Pressure Saturated, or
- FM = Field Moisture Content
- UC 1000 = Unconfined Compression
 - Peak Shear Strength (psf)
- Perm = Permeability
- IBR = Illinois Bearing Ratio
- CBR = California Bearing Ratio



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**Soil Classification Chart
& Key to Test Data**
Northwestern Steel & Wire Company
Sterling, Illinois

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DATE 01/15/92

PLATE
A2
REVISED DATE

00001/

Laboratory
TestsTxUU-S 1600 (250)
TxUU-S 1200 (500)Blows/ft
Moisture
Cont. (%)
Dry
Density
(pcf)5 17.3 110
17.8 110

9

4

46

42

26

21

64

Depth ft
Sample

0

5

9

4

46

42

26

21

64

35

40

45

50

Equipment CME-55: 5" HSA

Elevation 640.0 ft Date 7/24/91

DARK GRAY TO BLACK GRAVEL (GP) [FILL-SLAG]
hard drillingBLACK LEAN CLAY (CL)
medium stiff, dry to moist, with sand, trace silt, color
change to brown at 4.5 feetLIGHT BROWN SAND (SP)
loose, moist to wet, fine to medium grained, trace gravel

dense, fine to coarse grained

medium dense, groundwater encountered at 23 feet

LIGHT BROWN SAND (SP)
medium dense, saturated, medium to coarse grained, with
gravel, trace silt

very dense, hard drilling at 34 feet

LIGHT GRAY CLAY (CL)
hard, moist, trace sand and gravel
LIGHT BROWN LIMESTONEBoring terminated at 40.0 feet.
Groundwater encountered at 23 feet during drilling,
stabilized water level not measured.
Boring backfilled with drill cuttings.

Log of Boring LP- 1

(sheet 1 of 1)

Stabilized PC Sludge Landfill
Northwestern - Sterling, Illinois

PLATE

A3

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MJDJOB NUMBER
20480.031.23APPROVED
GADATE
1/92

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00001/

Laboratory
TestsTxUU-S 1150 (750)
TxUU-S 1065 (2000)Blows/ft
Moisture
Cont. (%)
Dry
Density
(pcf)6 18.7 107
16.5 112

8

19

35

23

26

42

Depth ft
Sample

0

5

10

15

20

25

30

35

40

45

50

Equipment CME-55: 5" HSA

Elevation 640.0 ft Date 7/24/91

DARK GRAY GRAVEL (GP) [FILL-SLAG]

BLACK LEAN CLAY (CL)

medium stiff, moist, with sand, trace silt
color change to dark brown at 4.5 feet

color change to black at 6 feet

BROWN SAND (SP)

loose, moist, fine to medium grained, trace gravel, trace
silt
less gravel

BROWN SAND (SP)

dense, moist, fine to coarse grained, with gravel

medium dense

BROWN LIMESTONE

weathered

Boring terminated at 29.25 feet.
Groundwater not encountered during drilling.
Boring backfilled with drill cuttings.Harding Lawson Associates
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Log of Boring LP- 2

(sheet 1 of 1)

Stabilized PC Sludge Landfill
Northwestern - Sterling, Illinois

PLATE

A4

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JOB NUMBER

20480.031.23

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DATE

1/92

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Laboratory
Tests

LL = 40 PI = 18

Blows/ft
Moisture
Cont. (%)
Dry
Density
(pcf)

14

12 26.3 93

5

10

22

27

35

> 50

Depth ft
Sample

Equipment CME-55: 5" HSA

Elevation 634.0 ft Date 7/23/91

0 DARK GRAY TO BROWN ORGANIC CLAY (OL)
dry, with silt, with roots (topsoil)

5 MOTTLED LIGHT BROWN TO GRAY LEAN CLAY (CL)
stiff, moist, with silt

perched water encountered at 7.25 feet
color change to gray, medium stiff, saturated, with sand
moist at 8.5 feet

10 LIGHT BROWN GRAVEL (GP)
medium dense, moist to wet, with medium-to
coarse-grained sand

BROWN SAND (SP)
medium dense, moist, fine to coarse grained, trace
fine-grained gravel, trace silt

15

20 GRAY-BROWN LEAN CLAY (CL)
very stiff, moist, with silt, trace gravel, trace
medium-grained sand

25 hard at 24 feet

hard drilling at 27 feet
water encountered at 28 feet

30 BROWN CLAY (CL)
hard, saturated, with sand (weathered limestone)

Boring terminated at 28.75 feet.
Perched water encountered at 7.25 feet; groundwater
encountered at 28 feet during drilling.
Boring backfilled with drill cuttings.
Stabilized water level not measured.

35

40

45

50



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Log of Boring LP- 3

(sheet 1 of 1)

PLATE

Stabilized PC Sludge Landfill
Northwestern - Sterling, Illinois

A5

DRAWN
MJD

JOB NUMBER
20480.031.23

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JA

DATE
1/92

REVISED DATE

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Laboratory
TestsBlows/ft
Moisture
Cont. (%)
Dry
Density
(pcf)Depth ft
SampleEquipment CME-55: 5" HSA
Elevation 634.0 ft Date 7/23/91LL = 23 PI = 8
-200 = 42%10
9 10.2 107

26

50

21

30

16 7.4 122

0
LIGHT GRAY-BROWN ORGANIC CLAY (OL)
dry to moist, trace sand, trace gravel, with roots (topsoil)
10
LIGHT BROWN LEAN CLAY (CL)
stiff, dry to moist, with silt, trace sand, with roots5
LIGHT BROWN GRAVEL (GP)
medium dense, dry to moist, with medium-grained sand10
LIGHT BROWN TO GRAY SAND (SP) dense, dry to
moist, fine to medium grained, with gravel15
LIGHT BROWN-GRAY SAND (SP)
medium dense, dry to moist, medium to coarse grained,
trace gravel20
perched water encountered at 17 feet
BROWN LEAN CLAY (CL)
very stiff, moist, trace coarse-grained sand25
LIGHT GRAY CLAYEY SAND (SC)
medium dense, moist, trace gravel30
LIGHT BROWN LIMESTONE
Boring terminated at 26.25 feet.
Perched water encountered at 17 feet; stabilized water
level not measured.
Boring backfilled with drill cuttings

35

40

45

50

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Log of Boring LP- 4

(sheet 1 of 1)

PLATE

Stabilized PC Sludge Landfill
Northwestern - Sterling, Illinois

A6

DRAWN

JOB NUMBER

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DATE

REVISED DATE

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1/92

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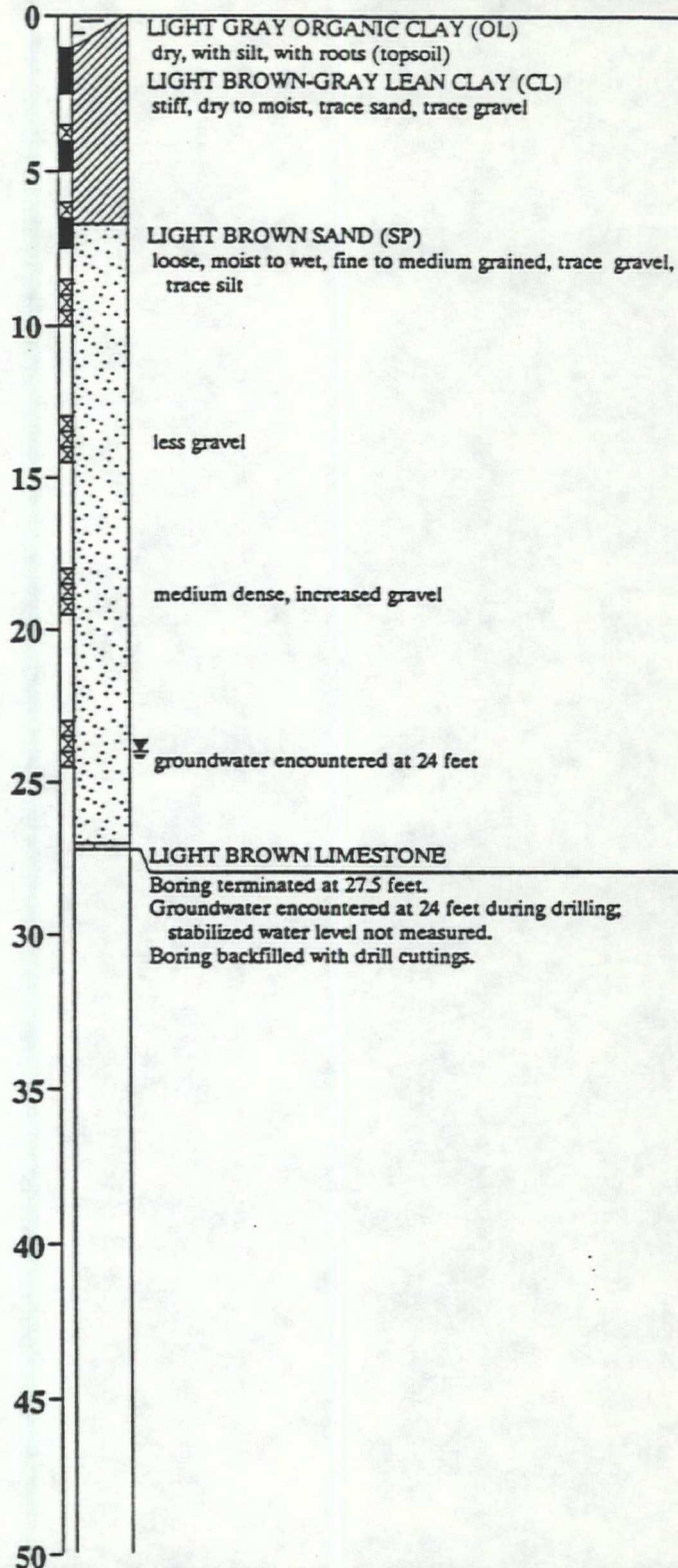
Laboratory
Tests

TxUU-S 1750 (750)

Blows/ft	Moisture Cont. (%)	Dry Density (pcf)
13		
9	25.7	97
10		
5		
9		
13		
17		

Depth ft
Sample

Equipment	CME-55: 5" HSA	
Elevation	634.0 ft	Date 7/23/91



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Log of Boring LP- 5 (sheet 1 of 1)
Stabilized PC Sludge Landfill
Northwestern - Sterling, Illinois

PLATE

A7

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JOB NUMBER
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A

DATE
1/92

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000017

Laboratory
TestsConsol
LL = 42 PI = 19

TxUU-S 970 (1750)

-200 = 43%

Blows/ft
Moisture
Cont. (%)
Dry
Density
(pcf)12 13.6 88
12.8

15 17.0 100

6 12.3 112

11 4.8 122

23

17

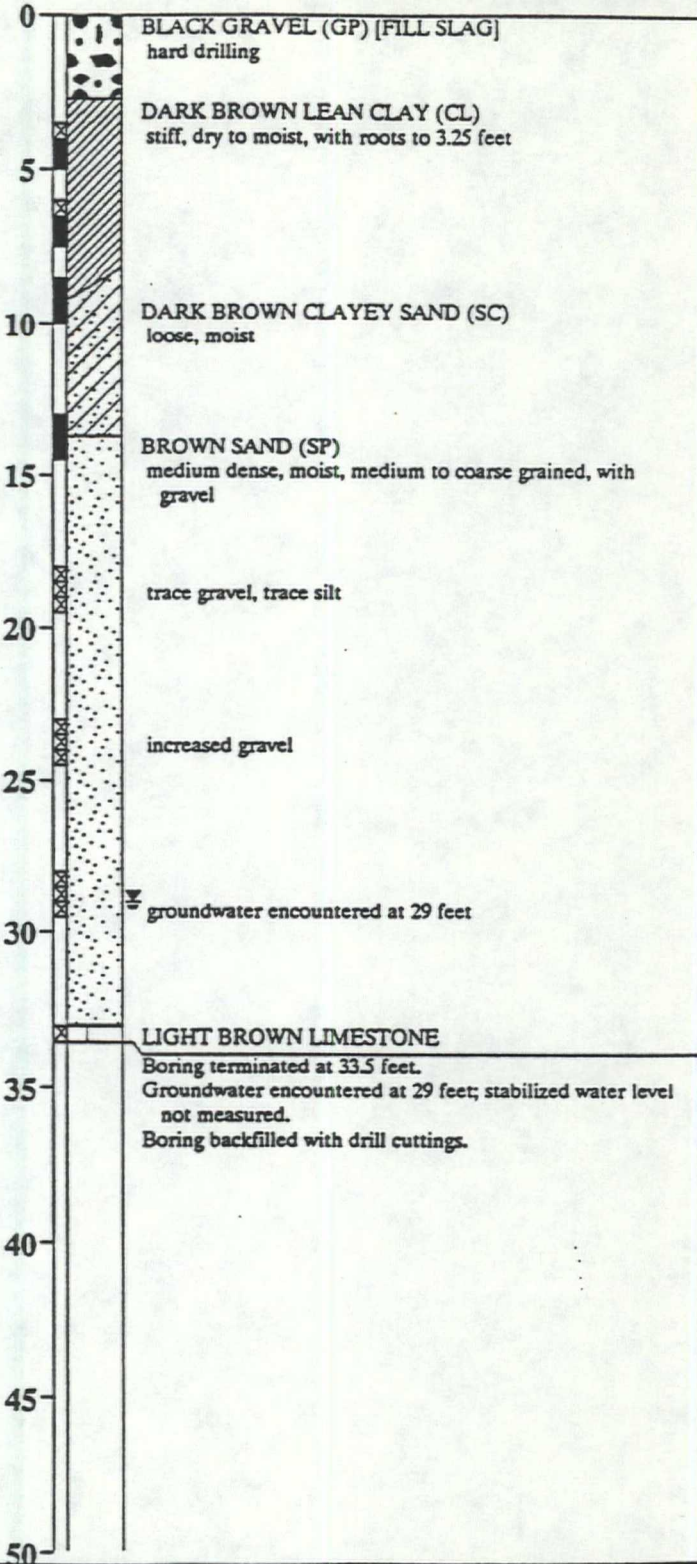
15

> 50

Depth ft
Sample

Equipment CME-55: 5" HSA

Elevation 640.0 ft Date 7/24/91

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Log of Boring LP- 6

(sheet 1 of 1)

Stabilized PC Sludge Landfill
Northwestern - Sterling, Illinois

PLATE

A8

DRAWN

JOB NUMBER

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DATE

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20480.031.23

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1/92

00001/

Laboratory
TestsTxUU-S 1425 (250)
LL = 35 PI = 12

TxUU-S 1420 (1000)

Blows/ft
Moisture
Cont. (%)
Dry
Density
(pcf)12 24.0 94
26.6

7

9 16.6 110

4

5

20

19

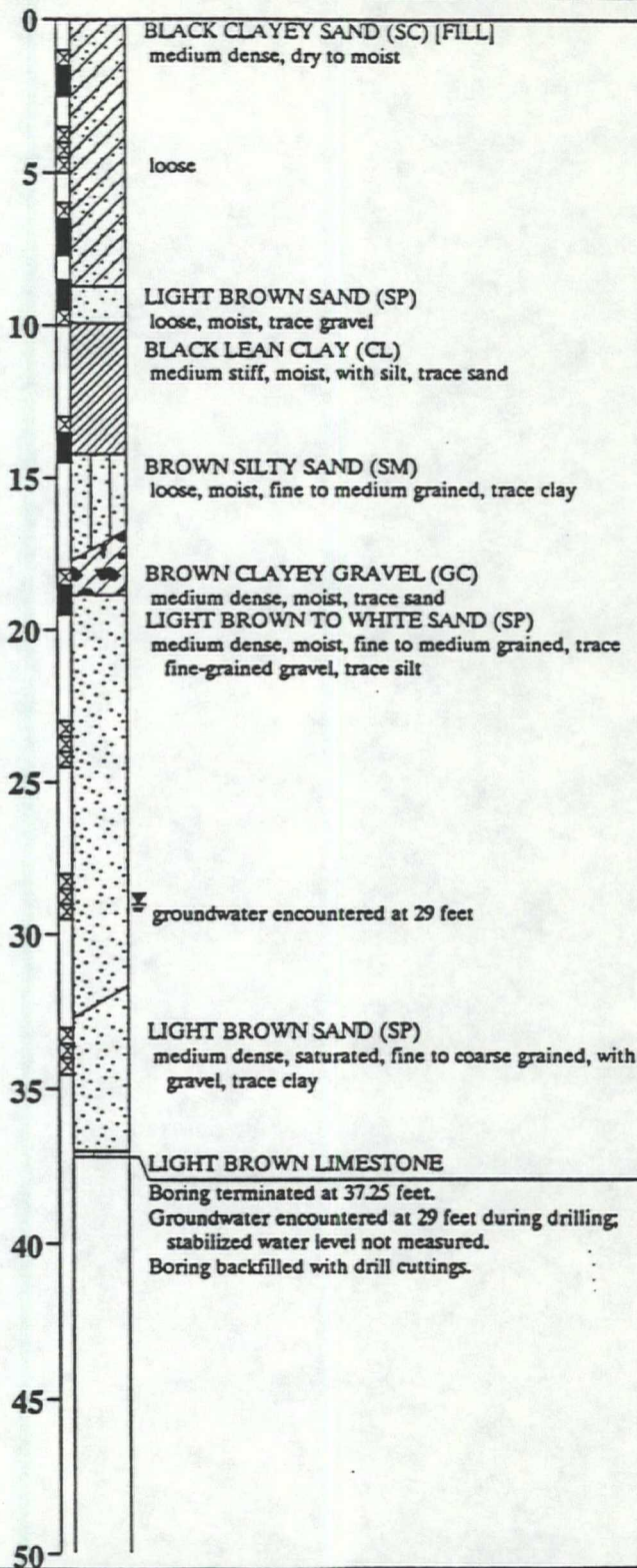
25

16

Depth ft
Sample

Equipment CME-55: 5" HSA

Elevation 643.0 ft Date 7/24/91

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Log of Boring LP- 7

(sheet 1 of 1)

Stabilized PC Sludge Landfill
Northwestern - Sterling, Illinois

PLATE

A9

DRAWN

JOB NUMBER

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20480,031.23

1/92

Laboratory
Tests

PI = Non Plastic

Blows/ft &
Moisture
Cont. (%)
Dry
Density
(pcf)

5 31.5

6

Depth ft
Sample

0

5

10

15

Boring No.

LI-1

Equipment

CME-55: 5" HSA

Elevation

647.0 ft

Date

7/23/91

DARK GRAY-BLACK LEAN SILT (ML) [FILL]
medium stiff, dry to moist, stabilized sludge

Boring terminated at 5.0 feet.
Groundwater not encountered during drilling.
Boring backfilled with drill cuttings.

Laboratory
Tests

Blows/ft &
Moisture
Cont. (%)
Dry
Density
(pcf)

5

12

Depth ft
Sample

0

5

10

15

Boring No.

LI-2

Equipment

CME-55: 5" HSA

Elevation

645.0 ft

Date

7/23/91

DARK GRAY-BLACK LEAN SILT (ML) [FILL]
medium stiff, dry to moist, unstabilized sludge

stiff

Boring terminated at 5.0 feet.
Groundwater not encountered during drilling.
Boring backfilled with drill cuttings.



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Logs of Borings

Stabilized PC Sludge Landfill

Northwestern - Sterling, Illinois

PLATE

A10

DRAWN
MJD

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DATE
1/92

REVISED DATE

Laboratory
Tests

Blows/ft
Moisture
Cont. (%)
Dry
Density
(pcf)

12 27.8 92

7 32.9 87

Depth ft
Sample

Boring No. LI-3
Equipment CME-55: 5" HSA
Elevation 631.0 ft Date 7/23/91

DARK GRAY-BLACK LEAN SILT (ML) [FILL]
stiff, dry to moist, stabilized sludge

medium stiff

Boring terminated at 5.0 feet.
Groundwater not encountered during drilling.
Boring backfilled with drill cuttings.

10

15

Laboratory
Tests

Blows/ft
Moisture
Cont. (%)
Dry
Density
(pcf)

13 24.5 92

7 31.7 97

Depth ft
Sample

Boring No. LI-4
Equipment CME-55: 5" HSA
Elevation 640.0 ft Date 7/23/91

DARK GRAY-BLACK LEAN SILT (ML) [FILL]
medium stiff, dry to moist, unstabilized sludge

medium stiff

Drilling refusal encountered on slag aggregate at 3 feet;
moved drilling rig 2 feet, and redrilled.
Boring terminated at 5.0 feet.
Groundwater not encountered during drilling.
Boring backfilled with drill cuttings.

10

15



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Logs of Borings

Stabilized PC Sludge Landfill
Northwestern - Sterling, Illinois

PLATE

A11

DRAWN

JOB NUMBER

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MJD

20480.031.23

GA

1/92

Laboratory
Tests

-200 = 2%

Blows/ft &
Moisture
Cont. (%)
Dry
Density
(pcf)

8

4 4.5 103

5

9

24

Depth ft
Sample

Boring No. BA-1
Equipment CME-55: 5" HSA
Elevation 635.0 ft Date 7/17/91

LIGHT GRAY ORGANIC SILT (OL)
medium stiff, dry, with roots, trace fine sand (topsoil)
LIGHT BROWN LEAN SILT (ML)
medium stiff, dry to moist

BROWN SAND (SP)
loose, dry to moist, fine grained, trace gravel and silt

LIGHT BROWN-GRAY SAND (SP)
medium dense, moist, fine grained, trace silt

LIGHT BROWN SAND (SP)
medium dense, moist, medium to coarse grained, with
gravel

Boring terminated at 14.5 feet.
Groundwater not encountered during drilling.
Boring backfilled with drill cuttings.

Laboratory
Tests

-200 = 4%

MA

Blows/ft &
Moisture
Cont. (%)
Dry
Density
(pcf)

7 10.4 105

4 9.3 103

8

15

16

Depth ft
Sample

Boring No. BA-2
Equipment CME-55: 5" HSA
Elevation 635.0 ft Date 7/17/91

LIGHT GRAY TO LIGHT BROWN ORGANIC CLAY
(OL)
dry, trace sand and gravel, with roots, (topsoil)
LIGHT BROWN LEAN CLAY (CL)
soft, moist, trace sand

LIGHT BROWN SAND (SP)
loose, dry to moist, fine to medium grained, trace silt

LIGHT BROWN TO GRAY SAND (SP)
medium dense, dry to moist, fine to medium grained, with
gravel, trace silt
gravel increasing with depths

Boring terminated at 14.5 feet.
Groundwater not encountered during drilling.
Boring backfilled with drill cuttings.



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Logs of Borings
Stabilized PC Sludge Landfill
Northwestern - Sterling, Illinois

PLATE

A12

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Laboratory
ests

LL = 43 PI = 20
200 = 96%

Blows/ft &
Moisture
Cont. (%)
Dry
Density
(pcf)

9

5 28.7 94

7 8.9 113

11

8

Depth ft
Sample

5

10

15

Boring No. BA-3
Equipment CME-55: 5" HSA
Elevation 635.0 ft Date 7/17/91

GRAY TO DARK BROWN ORGANIC CLAY (OL)
dry, trace sand and gravel, with roots (topsoil)

LIGHT BROWN LEAN CLAY (CL)
stiff, dry to moist, with roots

medium stiff

LIGHT BROWN SAND (SP)
medium dense, moist, coarse grained, trace gravel

LIGHT BROWN SAND (SP)
loose, moist, medium grained, with gravel, trace clay

Boring terminated at 14.5 feet.
Groundwater not encountered during drilling.
Boring backfilled with drill cuttings.

Laboratory
ests

Blows/ft &
Moisture
Cont. (%)
Dry
Density
(pcf)

10 7.7 99

4

13

31

22

Depth ft
Sample

5

10

15

Boring No. BA-4
Equipment CME-55: 5" HSA
Elevation 635.0 ft Date 7/17/91

GRAY TO BROWN ORGANIC CLAY (OL)
dry, with sand, trace silt, with roots (topsoil)

LIGHT BROWN SILTY SAND (SM)
medium dense, moist, trace clay, with roots

LIGHT BROWN TO DARK BROWN GRAVEL (GP)
loose, dry to moist, fine to coarse grained, with sand

medium dense

dense

LIGHT BROWN SAND (SP)
medium dense, moist, medium to coarse grained, with
gravel

Boring terminated at 14.5 feet.
Groundwater not encountered during drilling.
Boring backfilled with drill cuttings.



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Logs of Borings
Stabilized PC Sludge Landfill
Northwestern - Sterling, Illinois

PLATE

A13

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Laboratory
Tests

LL = 55 PI = 25
-200 = 89%

Blows/ft &
Moisture
Cont. (%)
Dry
Density
(pcf)

12 12.8 87

6 14.8 112

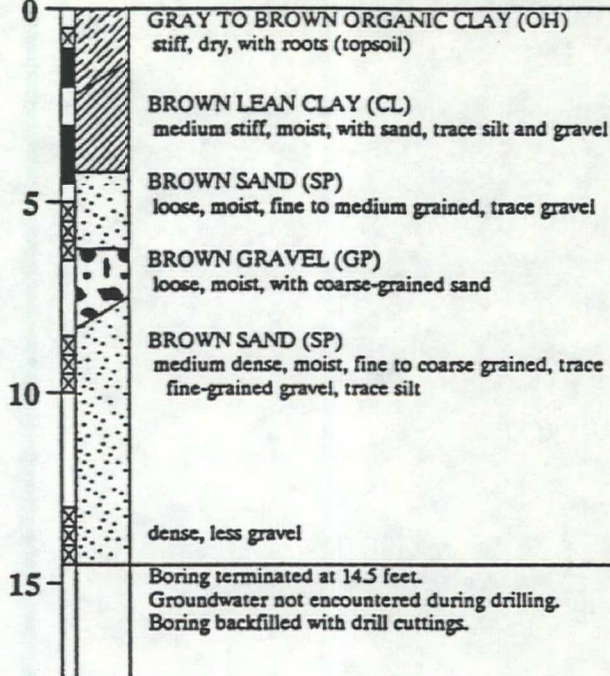
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13

31

Depth ft
Sample

Boring No. BA-5
Equipment CME-55: 5" HSA
Elevation 636.0 ft Date 7/17/91



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Logs of Borings
Stabilized PC Sludge Landfill
Northwestern - Sterling, Illinois

PLATE

A14

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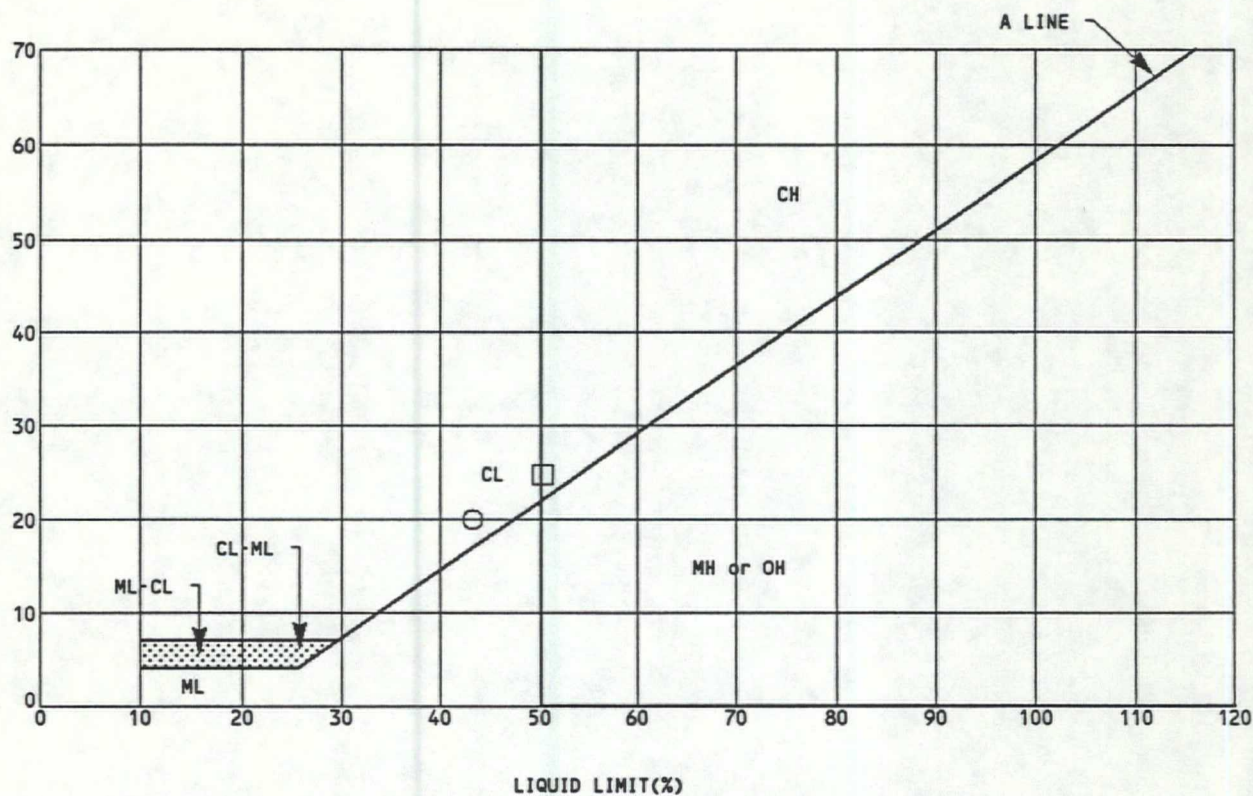
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Symbol	Source	Classification	Natural M.C.(%)	Liquid Limit(%)	Plasticity Index(%)	% Passing #200 Sieve
○	BA- 3 at 4.5'	BROWN LEAN CLAY (CL)		43	20	96
□	BA- 5 at 1.0'	BROWN ORGANIC CLAY (OH)		50	25	89



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Plasticity Chart

Stabilized P C Sludge Landfill
Northwestern - Sterling, Illinois

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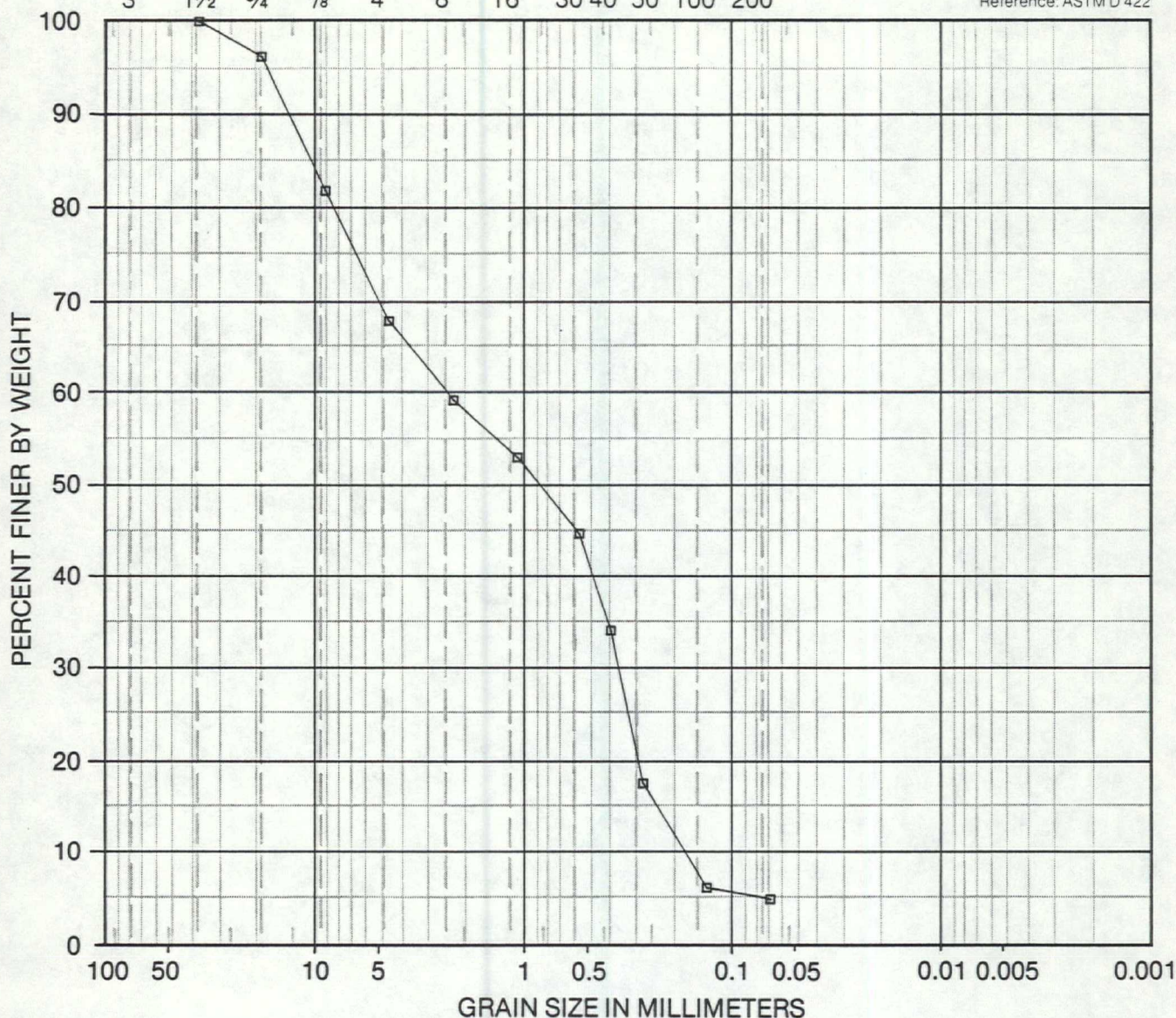
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DATE

U.S. Standard Sieve Size (in.) ——— U.S. Standard Sieve Numbers ——— Hydrometer

Reference: ASTM D 422



COBBLES	COARSE	FINE	COARSE	MEDIUM	FINE	SILT OR CLAY
	GRAVEL		SAND			

Symbol	Sample Source	Classification
■	BA-2 @ 8.5 FT	LIGHT BROWN TO GRAY SAND W/GRAVEL (SP)



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Particle Size Analysis
Stabilized P C Sludge Landfill
Northwestern - Sterling, Illinois

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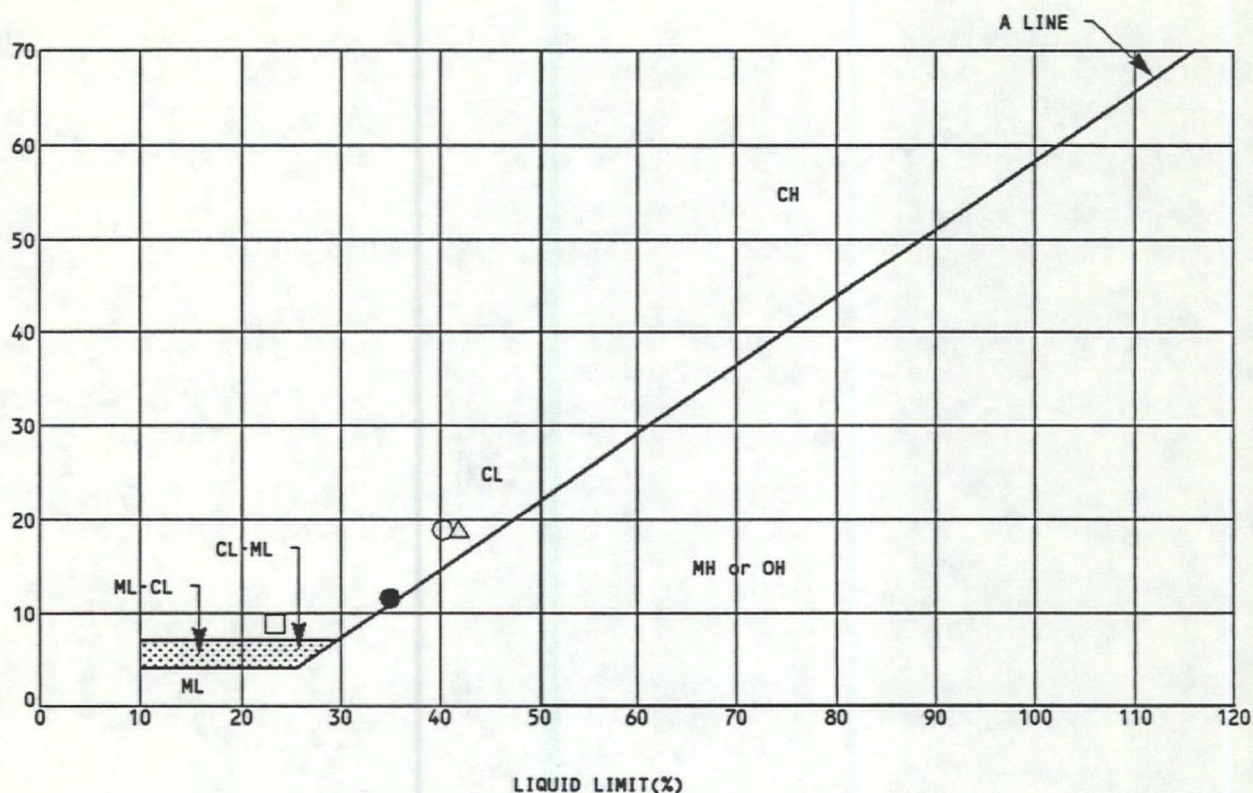
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Symbol	Source	Classification	Natural M.C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	LP- 3 at 4.0'	BROWN LEAN CLAY (CL)	13.6	40	19	42
□	LP- 4 at 24.0'	GRAY CLAYEY SAND (SC)		23	9	
△	LP- 6 at 4.5'	BROWN LEAN CLAY WITH SAND (CL)		42	19	
●	LP- 7 at 2.0'	BROWN CLAYEY SAND (SC)		35	12	



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Plasticity Chart

Stabilized P C Sludge Landfill
Northwestern - Sterling, Illinois

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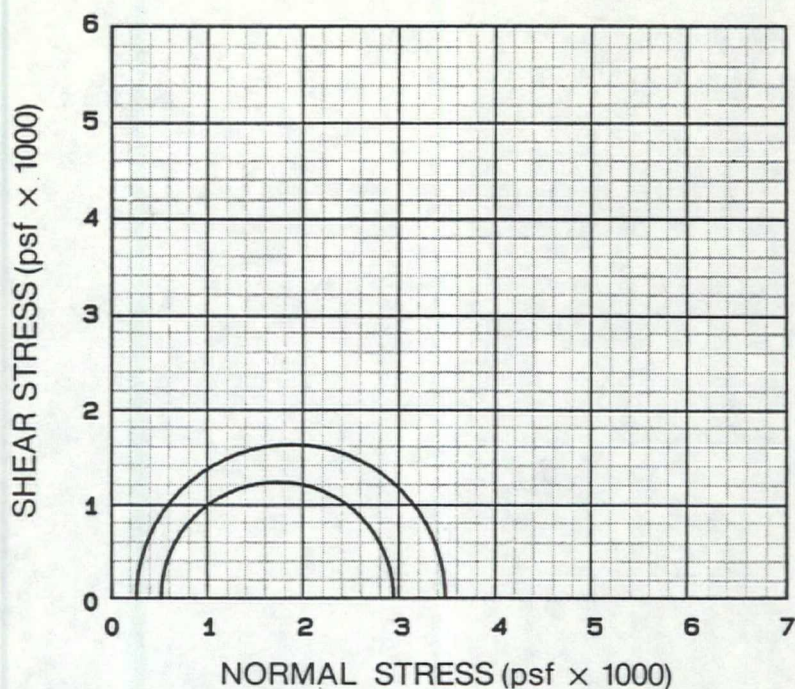
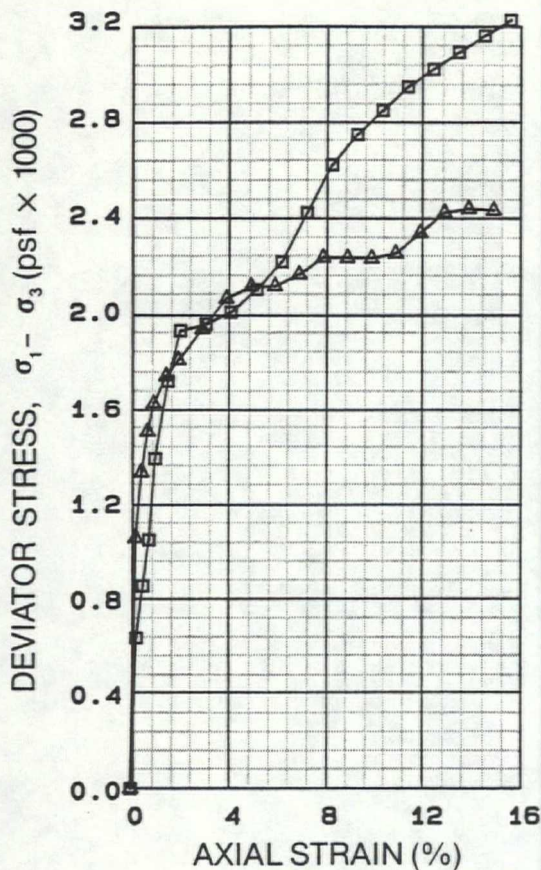
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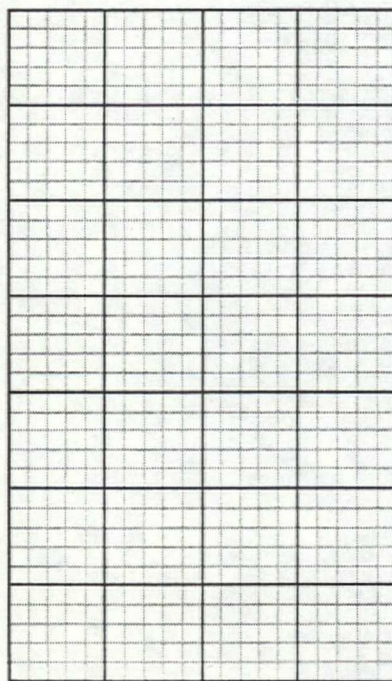
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PORE PRESSURE (psf \times 1000) σ_1 / σ_3



TEST TYPE: SATURATED UNCONSOL. UNDRAINED Controlled STRAIN

PHYSICAL CONDITIONS		TEST NO.		
		A ■	B ▲	C
INITIAL	Diameter (in.)	2.42	2.36	
	Height (in.)	5.47	5.23	
	Water Content (%)	17.3	17.8	
	Void Ratio	0.542	0.541	
	Saturation (%)	86.6	89.8	
	Dry Density (pcf)	110	110	
BEFORE	Consolidation Pressure (psf)			
	Backpressure (psf)	6192	7488	
	Water Content (%)			
	Void Ratio			
FINAL	Water Content (%)	17.9	19.3	
	Dry Density (pcf)	114	111	
	Void Ratio	0.484	0.525	
	Saturation (%)	100.0	100.0	
FAILURE	σ_1 Major Principal Stress (psf)	3442	2908	
	σ_3 Minor Principal Stress (psf)	250	500	
	Pore Pressure (psf)			
	Axial Strain at Failure (%)	15.7	15.0	
	Time to Failure (min.)	29	30	

Sample Source: LP-1 @ 4.0 FT , 4.5 FT

Classification:

BROWN LEAN CLAY W/SAND (CL)

G_s

2.71



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Triaxial Compression Test
Stabilized P C Sludge Landfill
Northwestern - Sterling, Illinois

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JOB NUMBER

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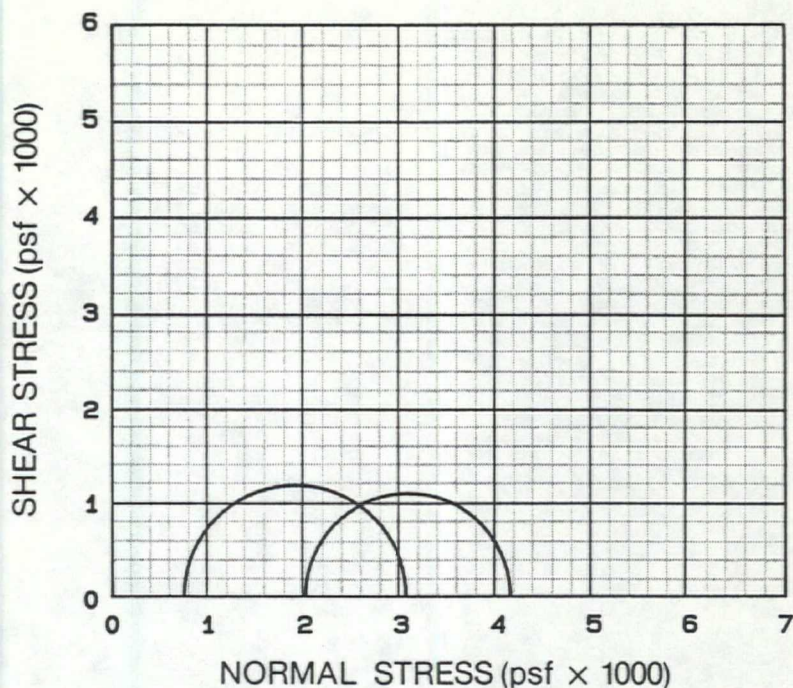
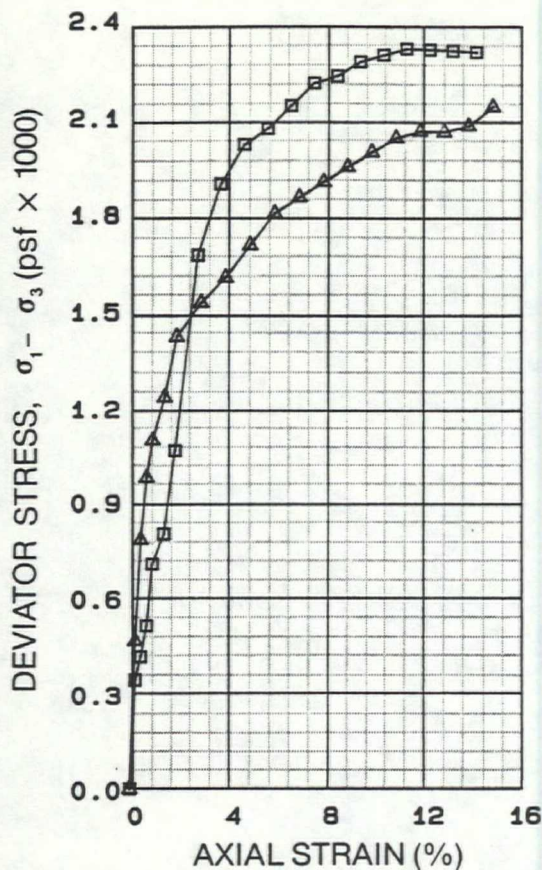
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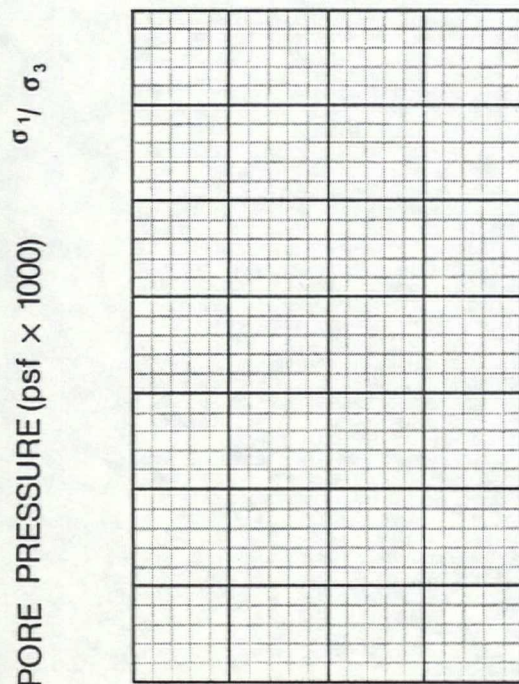
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TEST TYPE: SATURATED UNCONSOL, UNDRAINED Controlled STRAIN



PHYSICAL CONDITIONS		TEST NO.		
		A □	B ▲	C
INITIAL	Diameter (in.)	2.42	2.41	
	Height (in.)	5.72	5.25	
	Water Content (%)	18.7	16.5	
	Void Ratio	0.567	0.536	
	Saturation (%)	88.7	84.8	
	Dry Density (pcf)	107	112	
BEFORE	Consolidation Pressure (psf)			
	Backpressure (psf)	6048	6048	
	Water Content (%)			
	Void Ratio			
FINAL	Water Content (%)	18.7	17.3	
	Dry Density (pcf)	112	116	
	Void Ratio	0.502	0.476	
	Saturation (%)	100.0	100.0	
FAILURE	σ₁ Major Principal Stress (psf)	3045	4127	
	σ₃ Minor Principal Stress (psf)	750	2000	
	Pore Pressure (psf)			
	Axial Strain at Failure (%)	14.3	15.0	
	Time to Failure (min.)	27	30	

Sample Source: LP-2 @ 4.0 FT , 4.5 FT

Classification:

BROWN LEAN CLAY W/SAND (CL)

G_s

2.69



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Triaxial Compression Test
Stabilized P C Sludge Landfill
Northwestern - Sterling, Illinois

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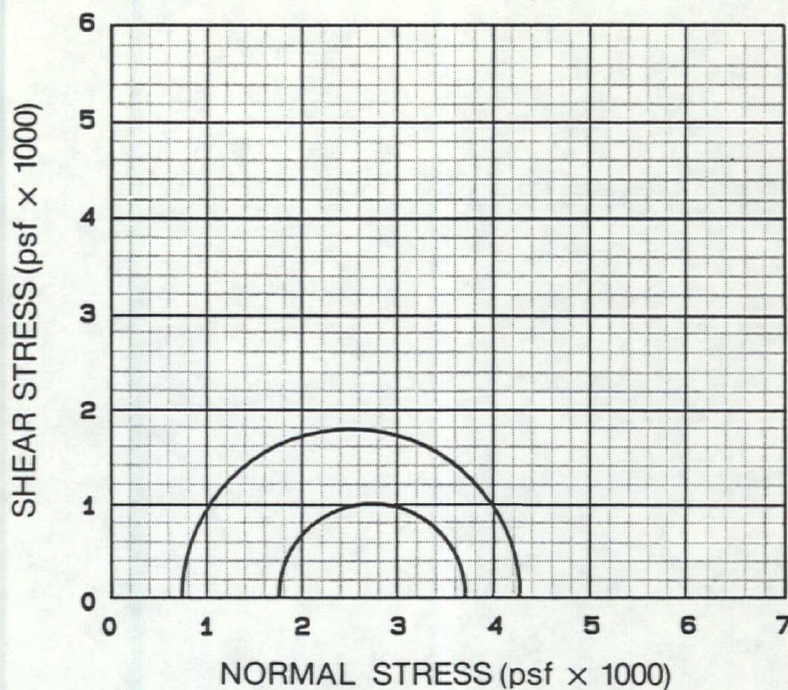
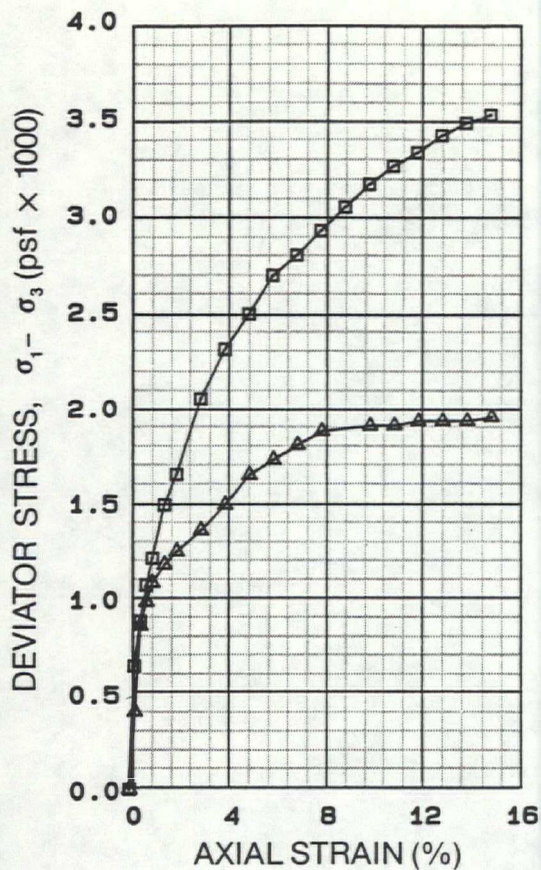
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TEST TYPE: SATURATED UNCONSOL. UNDRAINED Controlled STRAIN

PHYSICAL CONDITIONS		TEST NO.		
		A □	B ▲	C
INITIAL	Diameter (in.)	2.37	2.39	
	Height (in.)	5.75	5.40	
	Water Content (%)	25.7	17.0	
	Void Ratio	0.728	0.721	
	Saturation (%)	94.7	65.0	
	Dry Density (pcf)	97	100	
BEFORE	Consolidation Pressure (psf)			
	Backpressure (psf)	6048	6048	
	Water Content (%)			
	Void Ratio			
FINAL	Water Content (%)	28.2	23.2	
	Dry Density (pcf)	95	105	
	Void Ratio	0.757	0.641	
	Saturation (%)	100.0	100.0	
FAILURE	σ₁ Major Principal Stress (psf)	4252	3692	
	σ₃ Minor Principal Stress (psf)	750	1750	
	Pore Pressure (psf)			
	Axial Strain at Failure (%)	15.0	15.0	
	Time to Failure (min.)	28	27	

Sample Source: LP-5 @ 4.5 FT , LP-6 @ 7.0 FT

Classification: G_s

BROWN LEAN CLAY W/SAND (CL)

2.68



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Triaxial Compression Test
Stabilized P C Sludge Landfill
Northwestern - Sterling, Illinois

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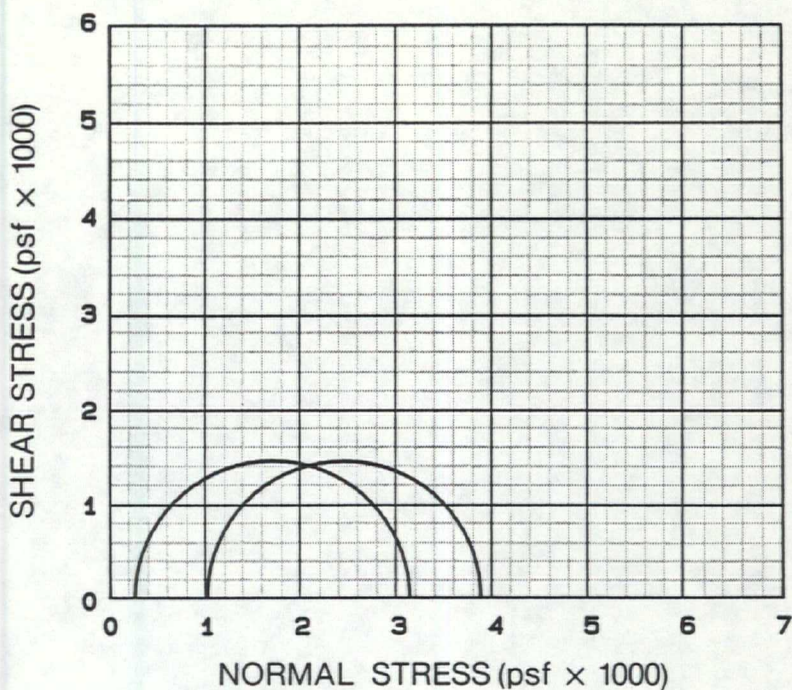
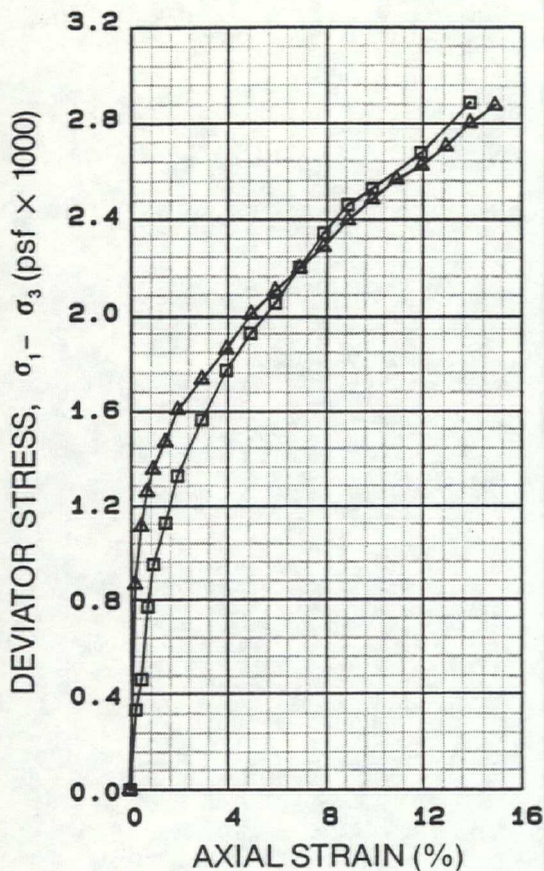
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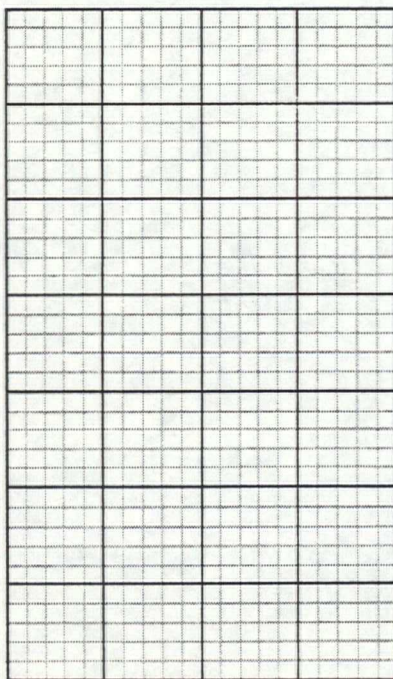
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SATURATED

TEST TYPE: UNCONSOL. UNDRAINED Controlled STRAIN

PORE PRESSURE (psf × 1000) σ_1 / σ_3



PHYSICAL CONDITIONS		TEST NO.		
		A □	B ▲	C
INITIAL	Diameter (in.)	2.38	2.43	
	Height (in.)	5.02	5.74	
	Water Content (%)	24.0	16.6	
	Void Ratio	0.820	0.548	
	Saturation (%)	79.9	83.0	
	Dry Density (pcf)	94	110	
BEFORE	Consolidation Pressure (psf)			
	Backpressure (psf)	6048	6048	
	Water Content (%)			
	Void Ratio			
FINAL	Water Content (%)	26.5	17.2	
	Dry Density (pcf)	99	116	
	Void Ratio	0.723	0.471	
	Saturation (%)	100.0	100.0	
FAILURE	σ_1 Major Principal Stress (psf)	3104	3843	
	σ_3 Minor Principal Stress (psf)	250	1000	
	Pore Pressure (psf)			
	Axial Strain at Failure (%)	14.0	15.0	
	Time to Failure (min.)	23	0	
Sample Source: LP-7 @ 2.0 FT , 6.5 FT				
Classification:				G_s
BROWN CLAYEY SAND (SC)				2.73



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Triaxial Compression Test
Stabilized P C Sludge Landfill
Northwestern - Sterling, Illinois

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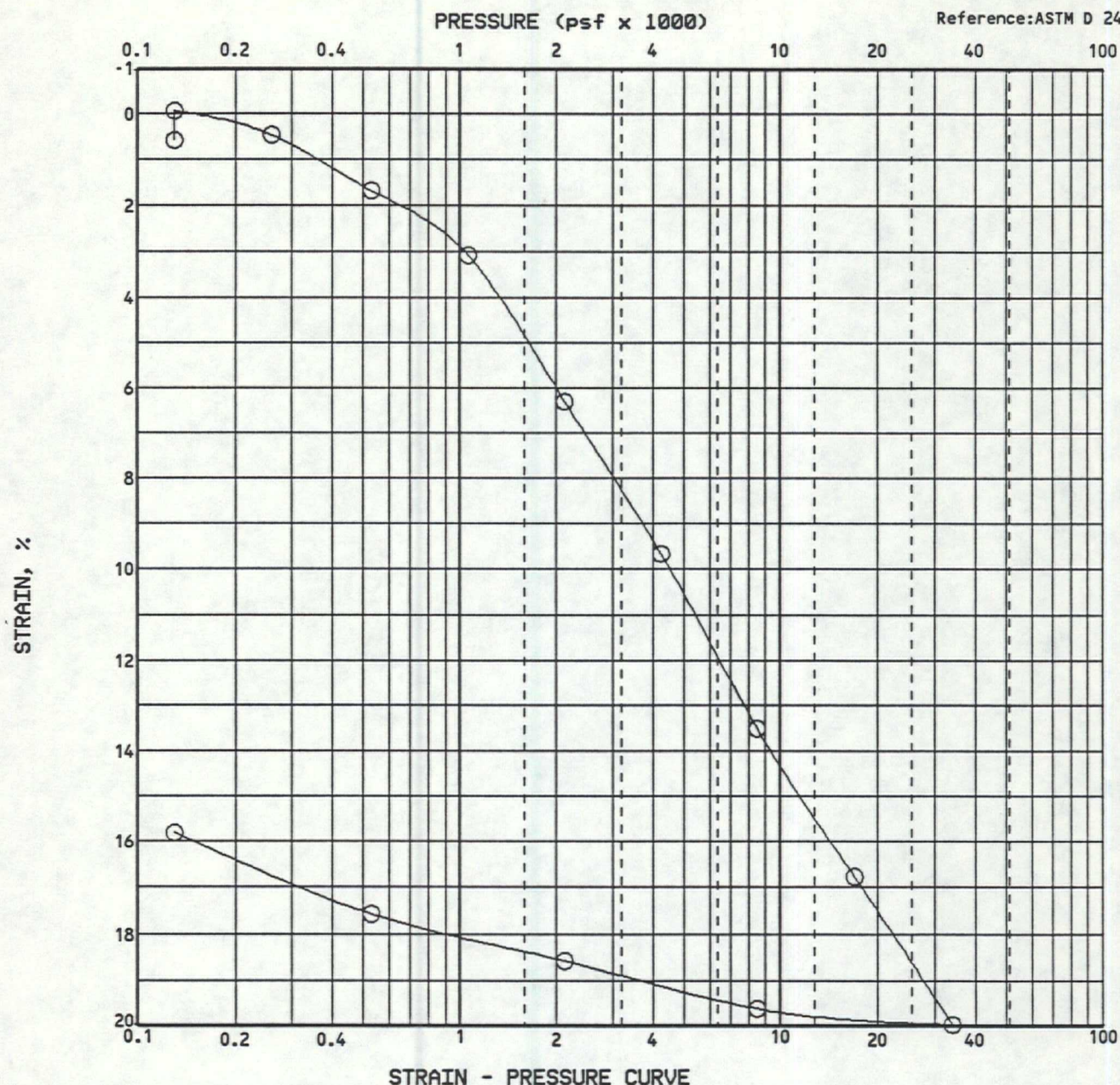
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Type of Specimen		S & H		Condition		Before Test		After Test	
Diameter(mm)	61.7	Height(mm)	20.3	Water Content	w_o	13.6	%	w_f	22.8 %
Overburden Press., P_o	550	psf		Void Ratio	e_o	0.903		e_f	0.609
Preconsol. Press., P_c	1,000	psf		Saturation	S_o	40	%	S_f	100 %
Compression Ratio, C_{ec}	0.22			Dry Density	d	88	pcf	d	104 pcf
LL	42	PL	23	PI	19	G_s	2.68		
Classification: BROWN LEAN CLAY WITH SAND (CL)						Source LP- 6 at 4.5'			



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Consolidation Test Report

Stabilized P C Sludge Landfill
Northwestern - Sterling, Illinois

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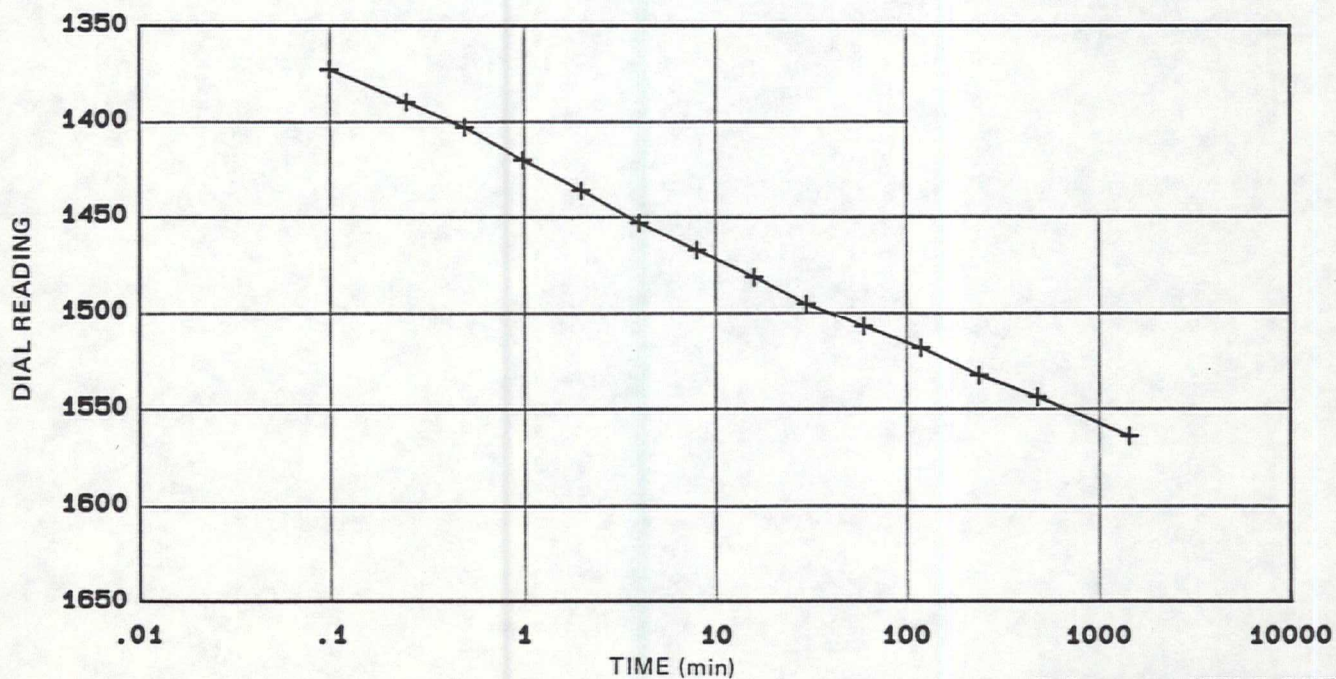
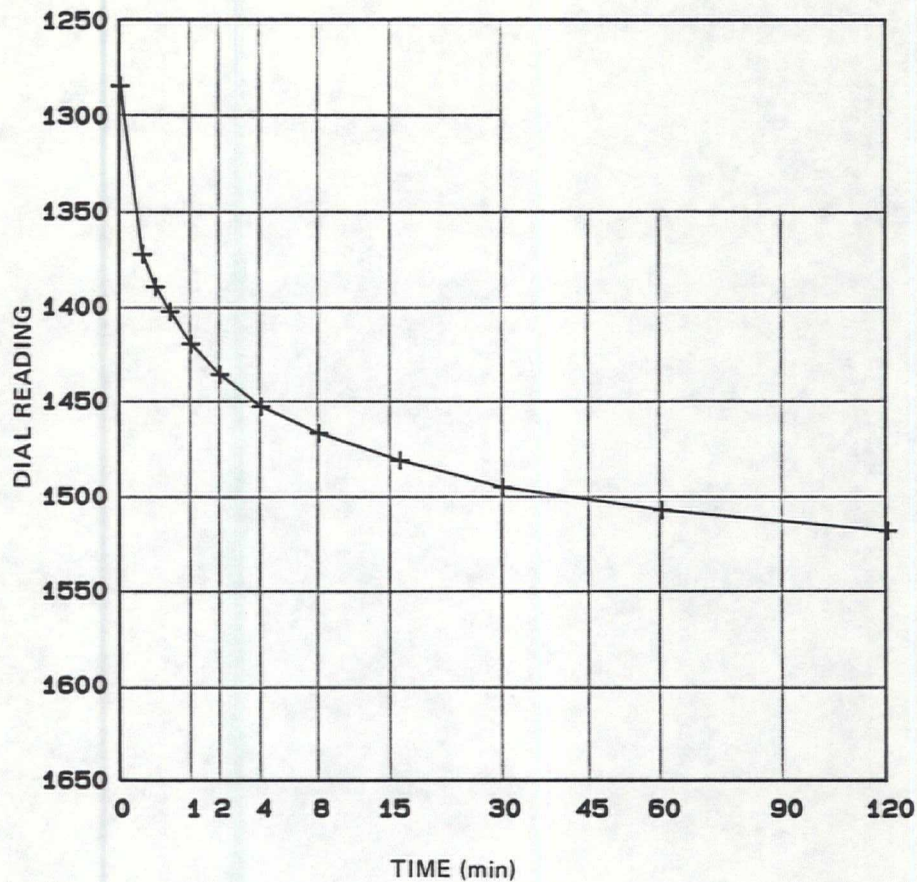
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BORING: LP-6

DEPTH: 4.5 ft.

PRESSURE: 2116 psf

TIME (min)	READING (div)
0.00	1285
0.10	1373
0.25	1390
0.50	1403
1.00	1420
2.00	1436
4.00	1453
8.00	1467
16.00	1481
30.00	1495
60.00	1507
120.00	1518
240.00	1532
480.00	1543
1440.00	1563



Reference: ASTM D-2435



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Consolidation Test - Time Curve Report

Stabilized P C Sludge Landfill
Northwestern - Sterling, Illinois

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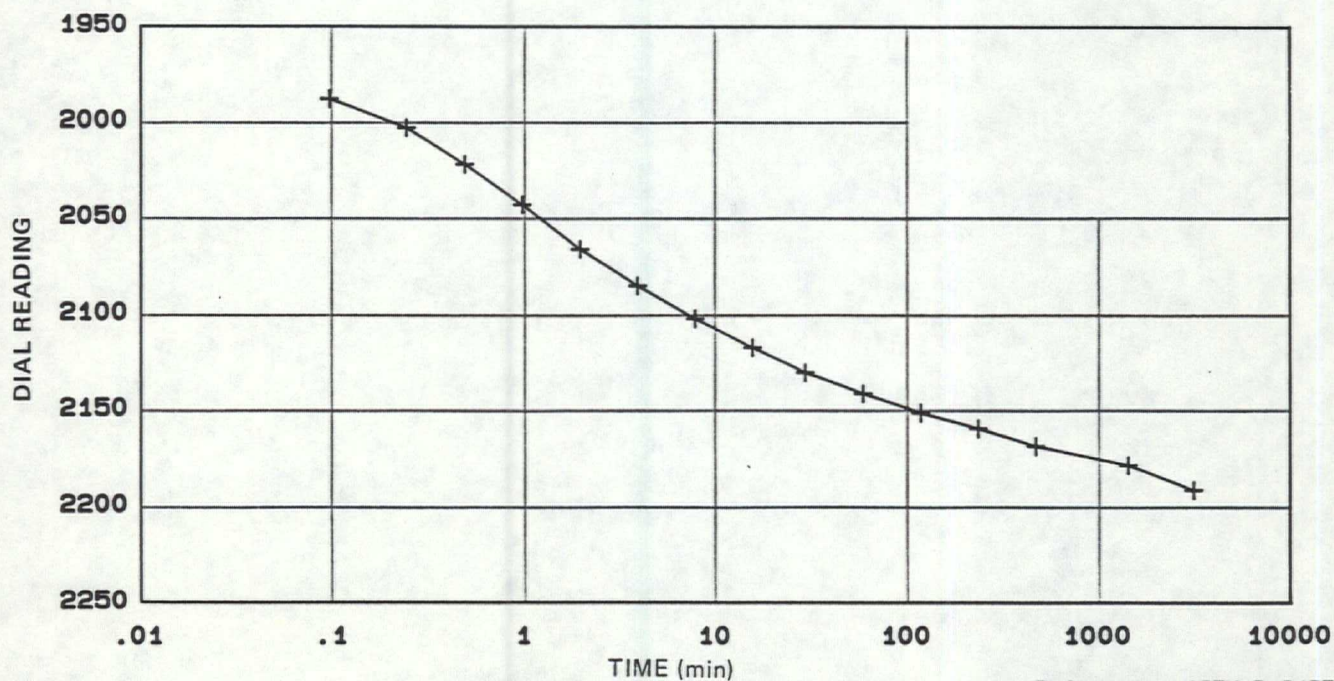
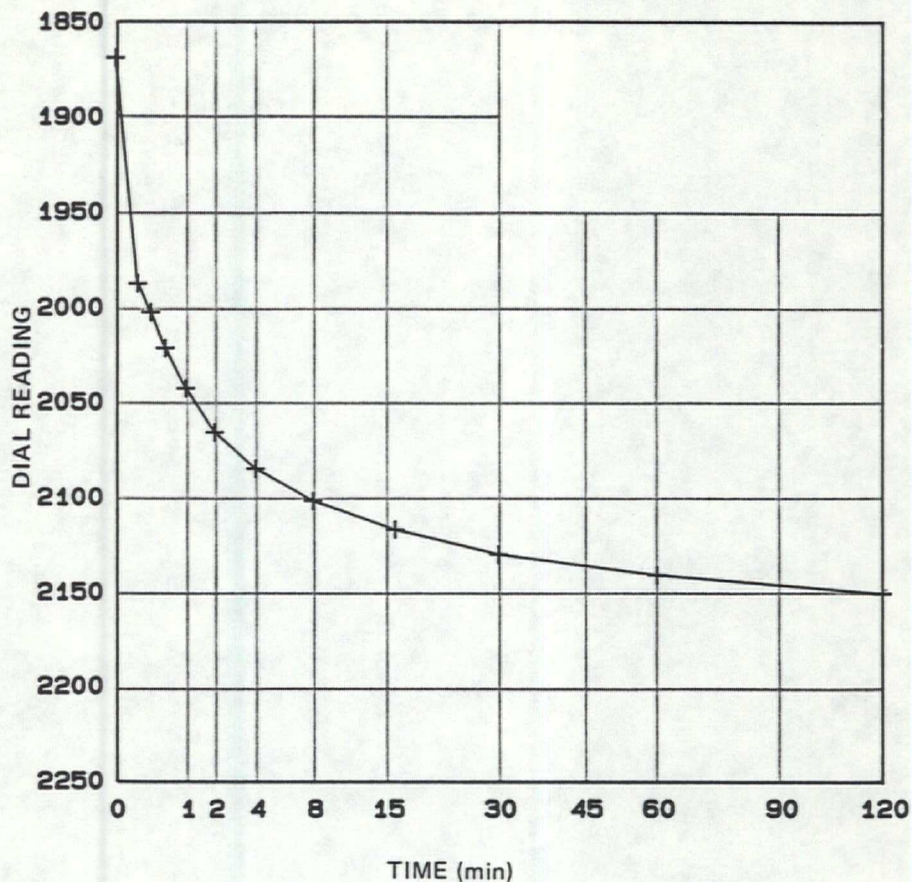
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BORING: LP-6

DEPTH: 4.5 ft.

PRESSURE: 8464 psf

TIME (min)	READING (div)
0.00	1870
0.10	1988
0.25	2003
0.50	2022
1.00	2043
2.00	2066
4.00	2085
8.00	2102
16.00	2117
30.00	2130
60.00	2141
120.00	2151
240.00	2159
480.00	2168
1440.00	2178
3135.00	2191



Reference: ASTM D-2435



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Consolidation Test - Time Curve Report

Stabilized P C Sludge Landfill
Northwestern - Sterling, Illinois

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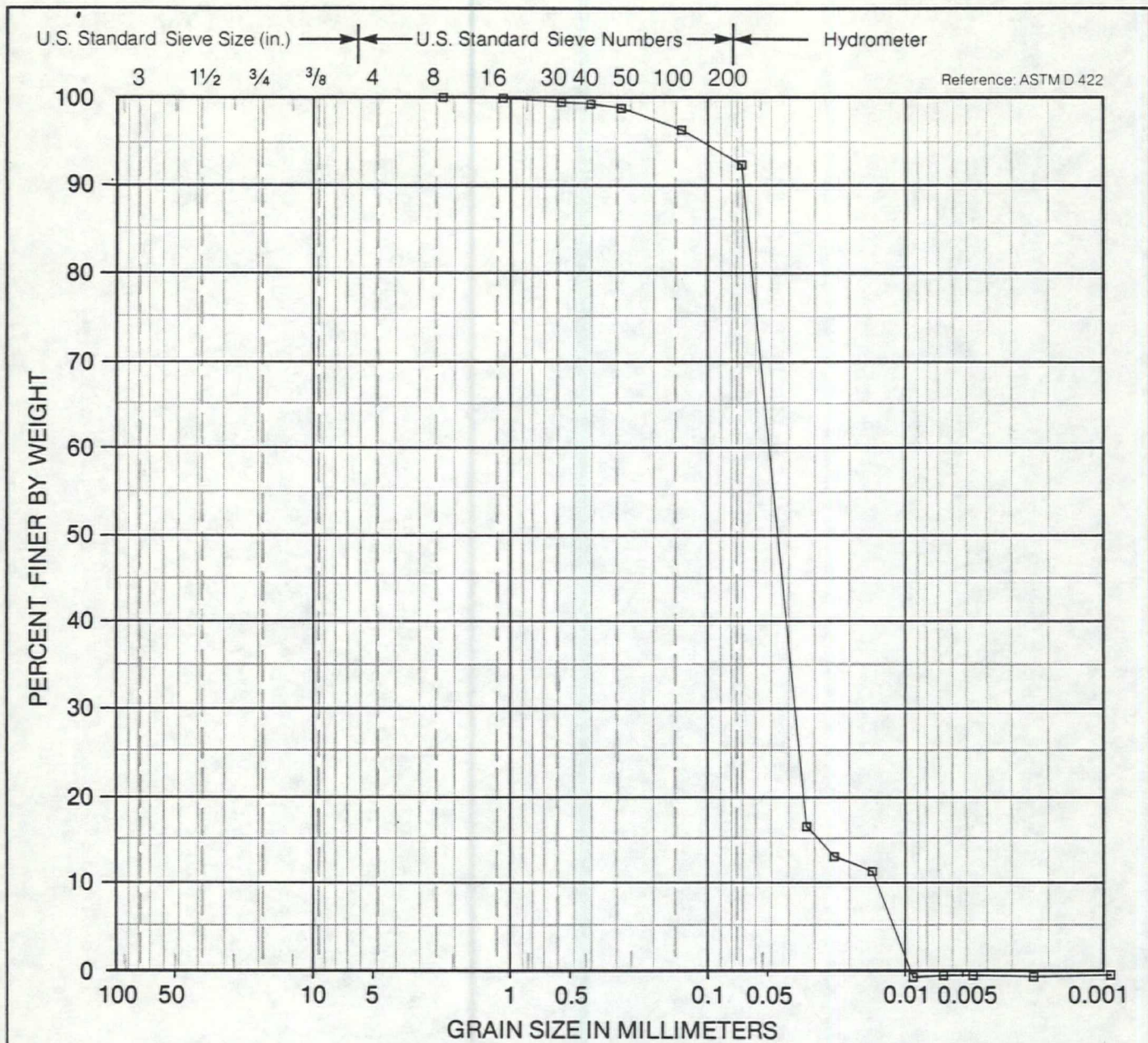
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COBBLES	COARSE	FINE	COARSE	MEDIUM	FINE	SILT OR CLAY
	GRAVEL		SAND			

Symbol	Sample Source	Classification
■	CELL B @ 0.0 FT	BROWN SILT (ML) / Stabilized K061



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Particle Size Analysis
Stabilized P C Sludge Landfill
Northwestern - Sterling, Illinois

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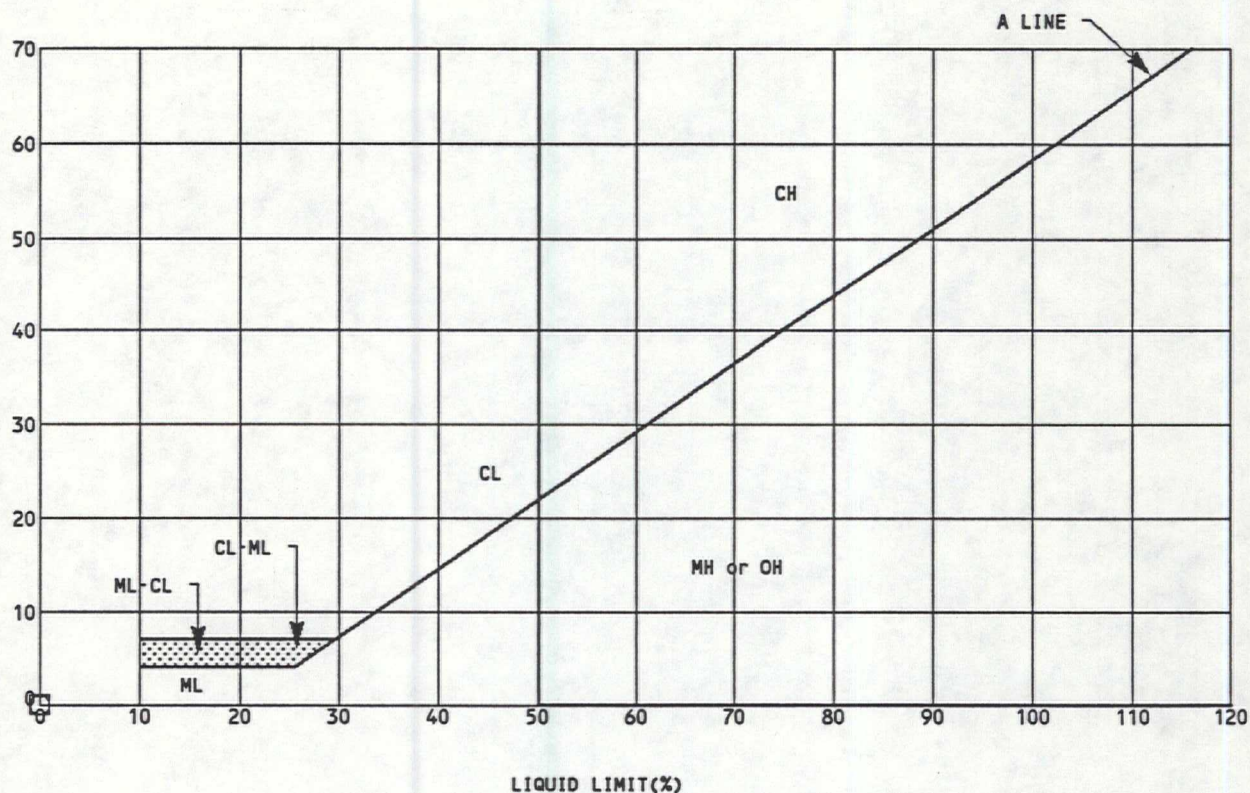
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Symbol	Source	Classification	Natural M.C.(%)	Liquid Limit(%)	Plasticity Index(%)	% Passing #200 Sieve
○	CELL B at 0.0'	BROWN SILT (ML): Stabilized K061	21.5	NP	NP	13
□	LI- 1 at 2.0'	DARK GRAY SILT (ML): Stabilized Sludge		NP	NP	



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Plasticity Chart

Stabilized P C Sludge Landfill
Northwestern - Sterling, Illinois

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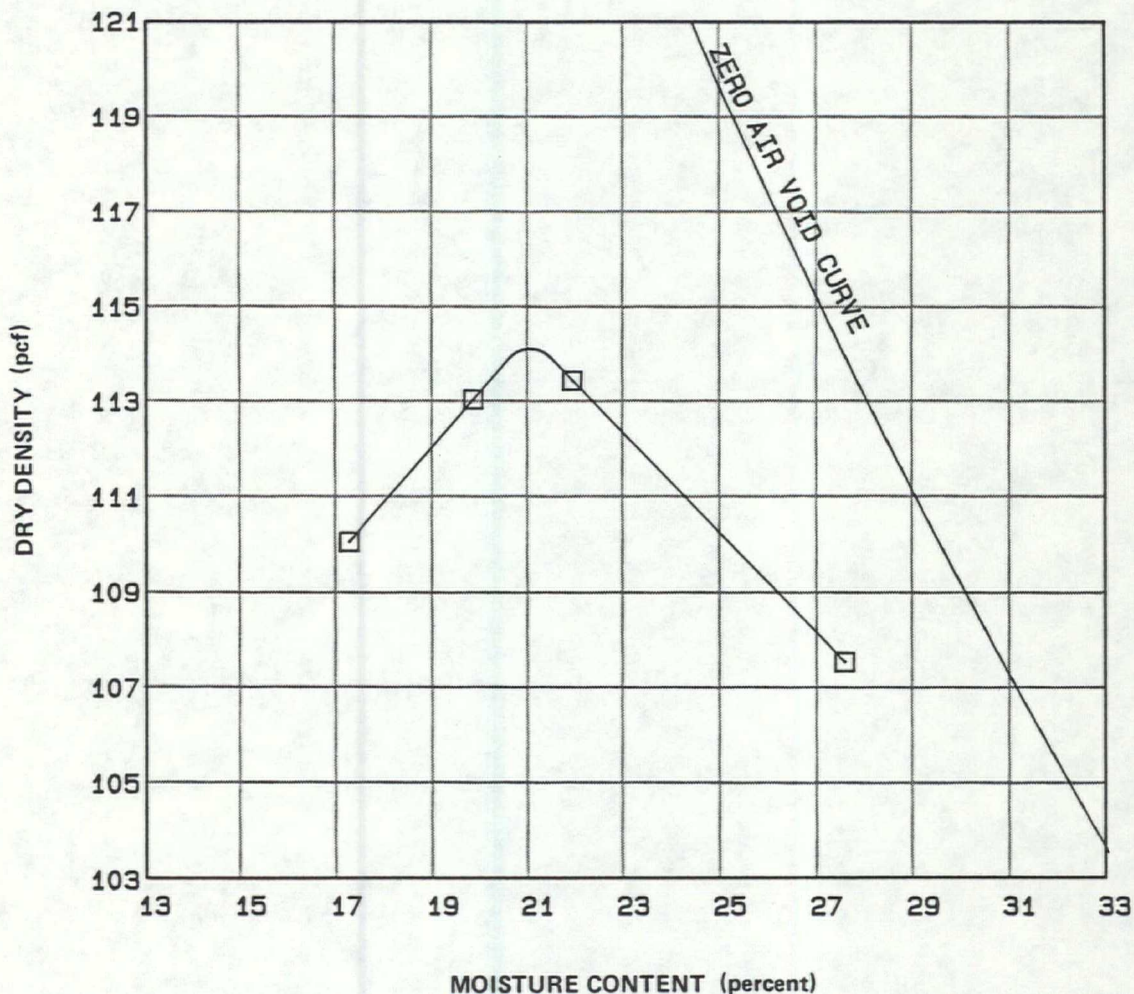
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MAXIMUM DRY DENSITY (pcf)	114
CORRECTED MAXIMUM DRY DENSITY (pcf)	114
OPTIMUM WATER CONTENT (%)	21.0



Reference: ASTM D-1557

	1	2	3	4
MOISTURE CONTENT (%)	17.2	19.8	21.8	27.5
DRY DENSITY (pcf)	110	113	113	108
% PASSING #20	100.0		SPECIFIC GRAVITY (g/cc)	
			3.67	
			MOLD DIAMETER	
			4.00	
CLASSIFICATION	BROWN SILT (ML)		SOURCE CELL B @ 0.0 FT	
	Stabilized K061			



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Compaction Test Report

Stabilized P C Sludge Landfill
Northwestern - Sterling, Illinois

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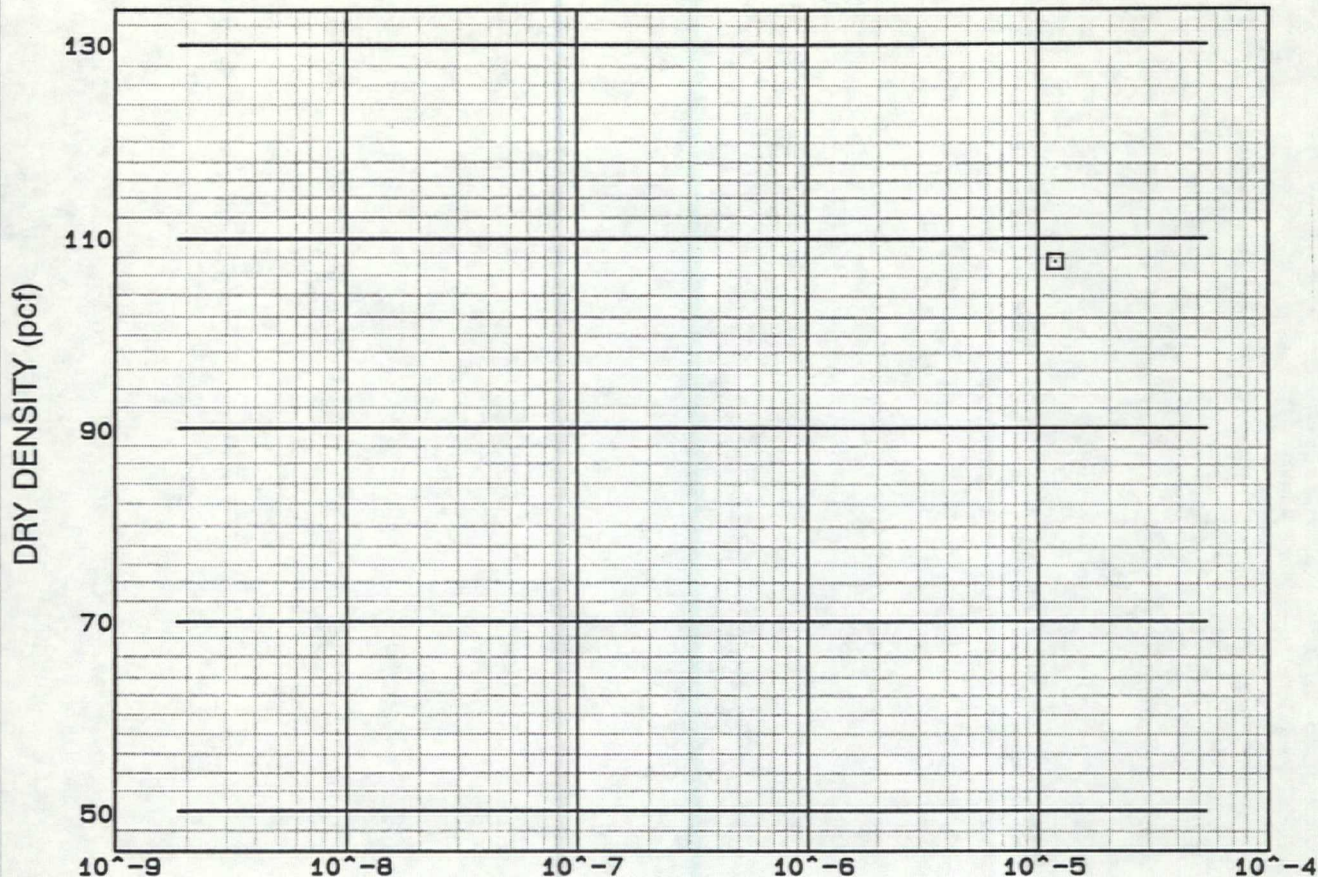
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COEFFICIENT OF PERMEABILITY (K) AT 20°C (cm/sec)

PHYSICAL CONDITIONS		TEST NO		
		A <input checked="" type="checkbox"/>	B	C
INITIAL	Diameter (in)	2.43		
	Height (in)	2.00		
	Water Content (%)	21.1		
	Dry Density (pcf)	104		
	Void Ratio	1.197		
	Saturation (%)	65		
FINAL	Consolidation Pressure (psf)	576		
	Water Content (%)	30.8		
	Dry Density (pcf)	107		
	Void Ratio	1.130		
	Saturation (%)	100		
Permeability At 20°C (cm/sec)		1.09 E-5		
Sample Source: <input checked="" type="checkbox"/> CELL B @ 0.0 FT				
Classification: <input checked="" type="checkbox"/> BROWN SILT (ML)				
Stabilized K061 / Remolded to 85% RC				

TEST TYPE: FALLING HEAD

SATURATION

METHOD: BACK PRESSURE



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Permeability Test Report

Stabilized P C Sludge Landfill
Northwestern - Sterling, Illinois

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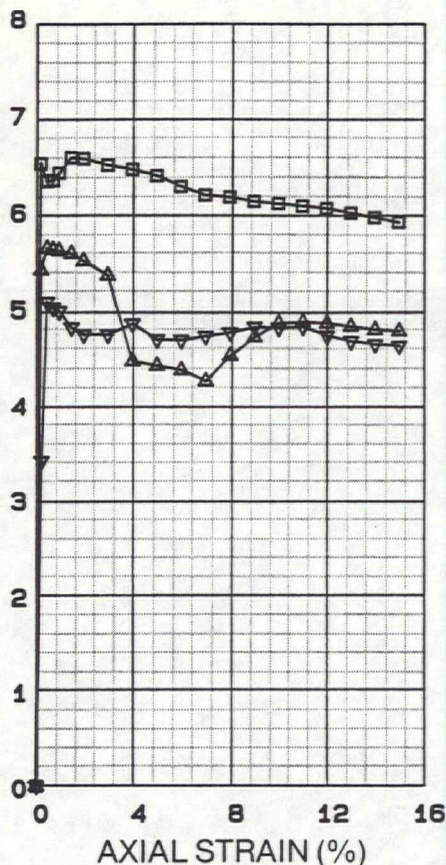
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DATE
08-15-1991

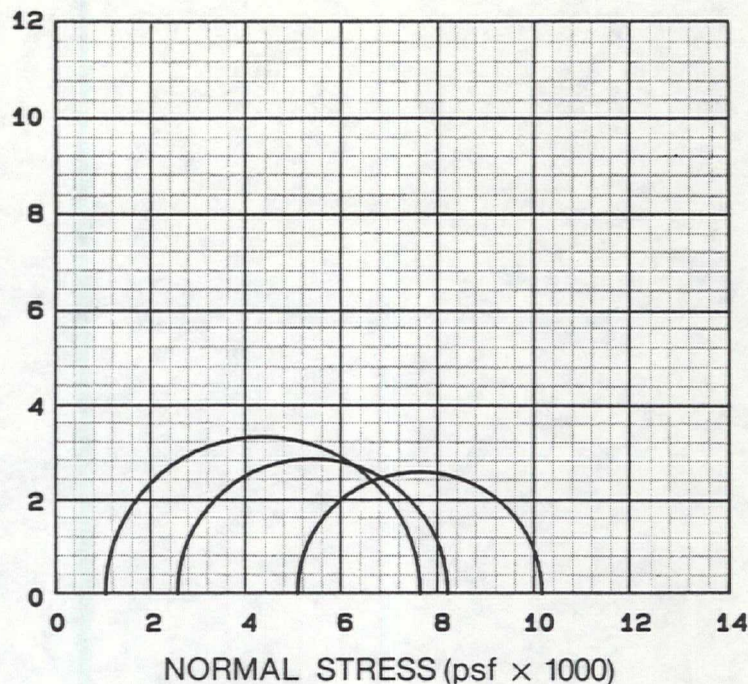
REVISED

DATE

DEVIATOR STRESS, $\sigma_1 - \sigma_3$ (psf $\times 1000$)



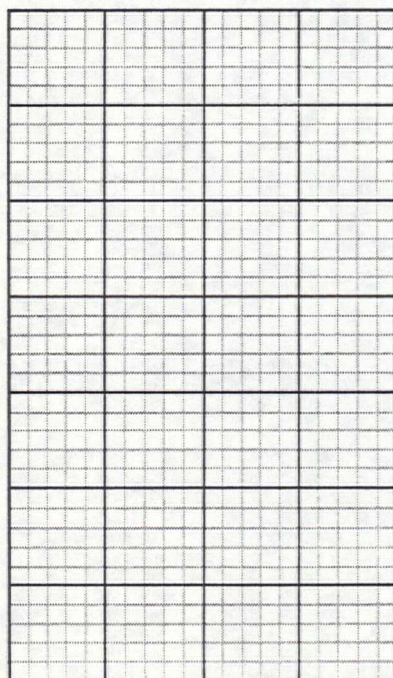
SHEAR STRESS (psf $\times 1000$)



SATURATED

TEST TYPE: UNCONSOL, UNDRAINED Controlled STRAIN

PORE PRESSURE (psf $\times 1000$) σ_1 / σ_3



PHYSICAL CONDITIONS		TEST NO.		
		A □	B ▲	C ▼
INITIAL	Diameter (in.)	2.43	2.43	2.43
	Height (in.)	6.00	6.00	6.00
	Water Content (%)	21.1	21.1	20.5
	Void Ratio	1.381	1.369	1.358
	Saturation (%)	56.1	56.7	55.4
	Dry Density (pcf)	96	97	97
BEFORE	Consolidation Pressure (psf)			
	Backpressure (psf)	6048	7488	4608
	Water Content (%)			
	Void Ratio			
FINAL	Water Content (%)	35.8	35.8	35.5
	Dry Density (pcf)	99	99	99
	Void Ratio	1.315	1.312	1.304
	Saturation (%)	100.0	100.0	100.0
FAILURE	σ_1 Major Principal Stress (psf)	7545	8108	10054
	σ_3 Minor Principal Stress (psf)	1000	2500	5000
	Pore Pressure (psf)			
	Axial Strain at Failure (%)	1.5	0.5	0.5
	Time to Failure (min.)	3	1	1
Sample Source: CELL B @ 0.0 FT				
Classification: BROWN SILT (ML) Stabilized K061 G_s 3.67				



Harding Lawson Associates
Engineers, Geologists
& Geophysicists

Triaxial Compression Test Remolded to 85% RC
Stabilized P C Sludge Landfill
Northwestern - Sterling, Illinois

DRAWN

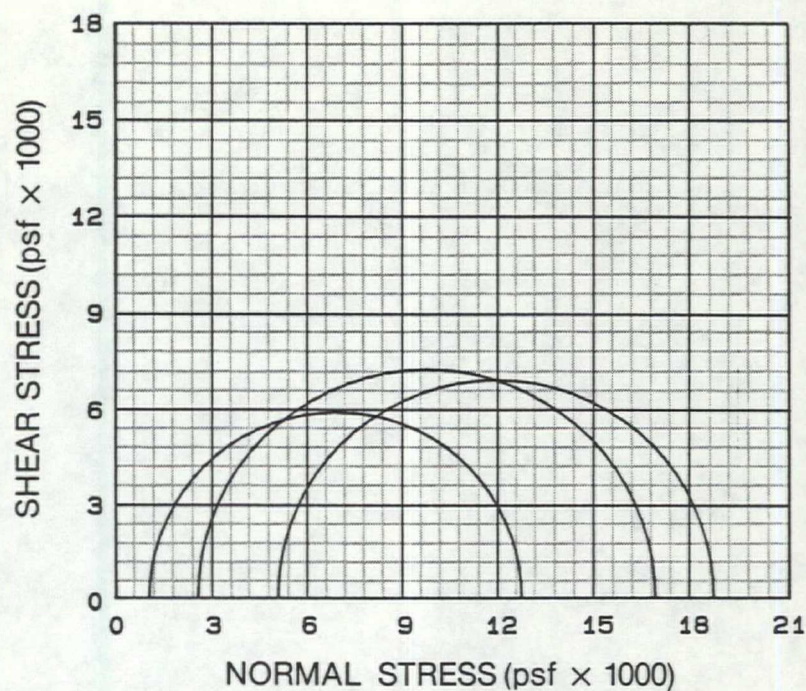
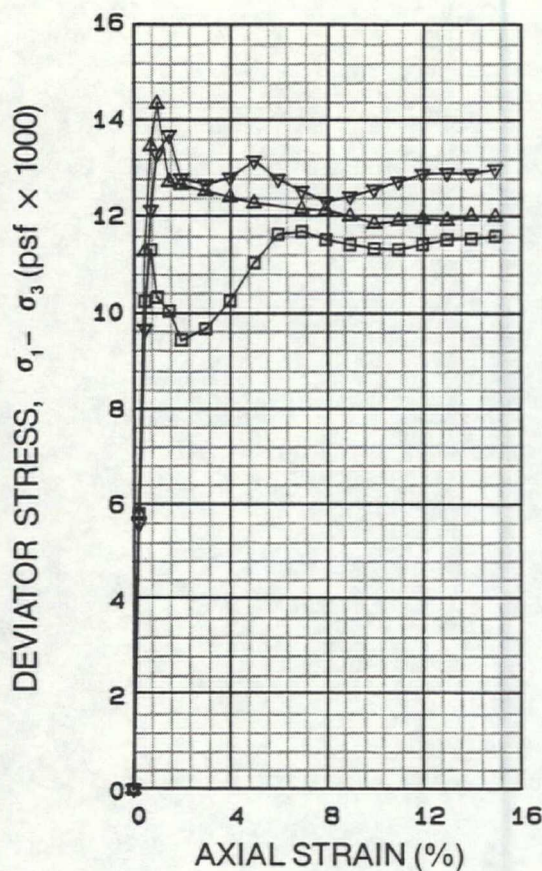
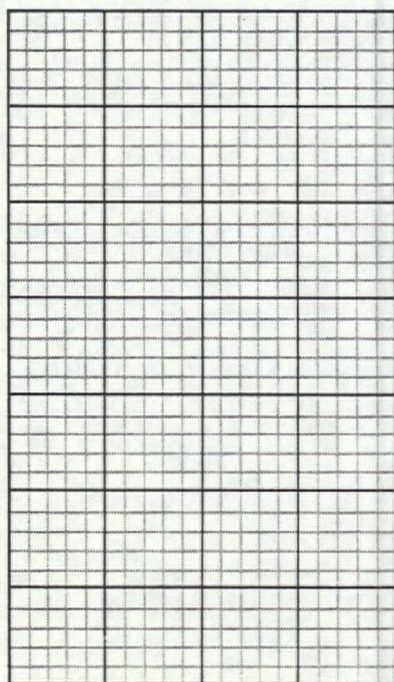
JOB NUMBER
20480.031.23

APPROVED
TAB

DATE
08-15-1991

REVISED

DATE

STRESS RATIO
(σ_1 / σ_3)PORE PRESSURE
(psf $\times 1000$)

SATURATED
TEST TYPE: UNCONSOL. UNDRAINED Controlled STRAIN

PHYSICAL CONDITIONS		TEST NO.		
		A □	B ▲	C ▼
INITIAL	Diameter (in.)	2.43	2.43	2.43
	Height (in.)	6.00	6.00	6.00
	Water Content (%)	20.6	21.2	21.0
	Void Ratio	1.180	1.187	1.188
	Saturation (%)	64.0	65.4	65.0
	Dry Density (pcf)	105	105	105
BEFORE	Consolidation Pressure (psf)			
	Backpressure (psf)	7632		7632
	Water Content (%)			
	Void Ratio			
FINAL	Water Content (%)	30.3		30.2
	Dry Density (pcf)	108		109
	Void Ratio	1.113		1.110
	Saturation (%)	100.0		100.0
FAILURE	σ_1 Major Principal Stress (psf)	12632	16779	18636
	σ_3 Minor Principal Stress (psf)	1000	2500	5000
	Pore Pressure (psf)			
	Axial Strain at Failure (%)	7.0	1.0	1.5
	Time to Failure (min.)	14	2	3
Sample Source: CELL B @ 0.0 FT				
Classification:				
BROWN SILT (ML) Stabilized K061				3.67



Harding Lawson Associates
Engineers, Geologists
& Geophysicists

Triaxial Compression Test
Stabilized P C Sludge Landfill
Northwestern - Sterling, Illinois

Remolded to 92% RC

DRAWN

JOB NUMBER
20480.031.23

APPROVED
TMB

DATE
08-19-1991

REVISED

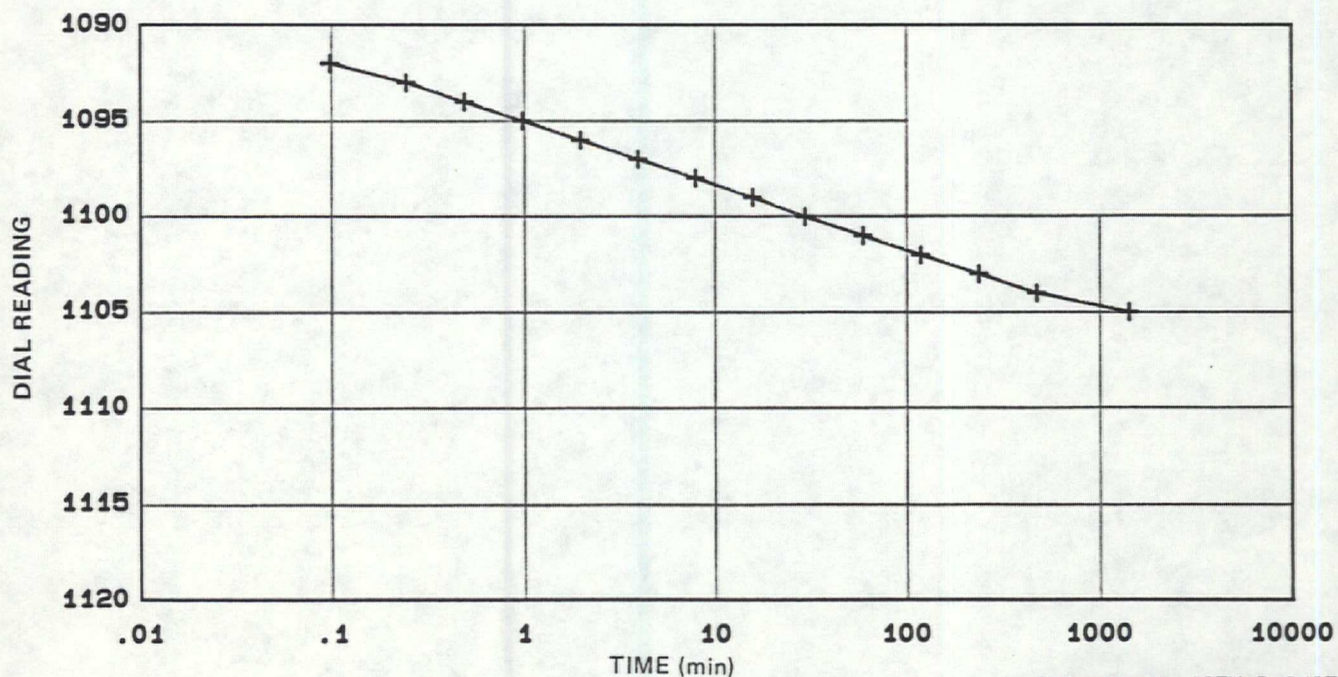
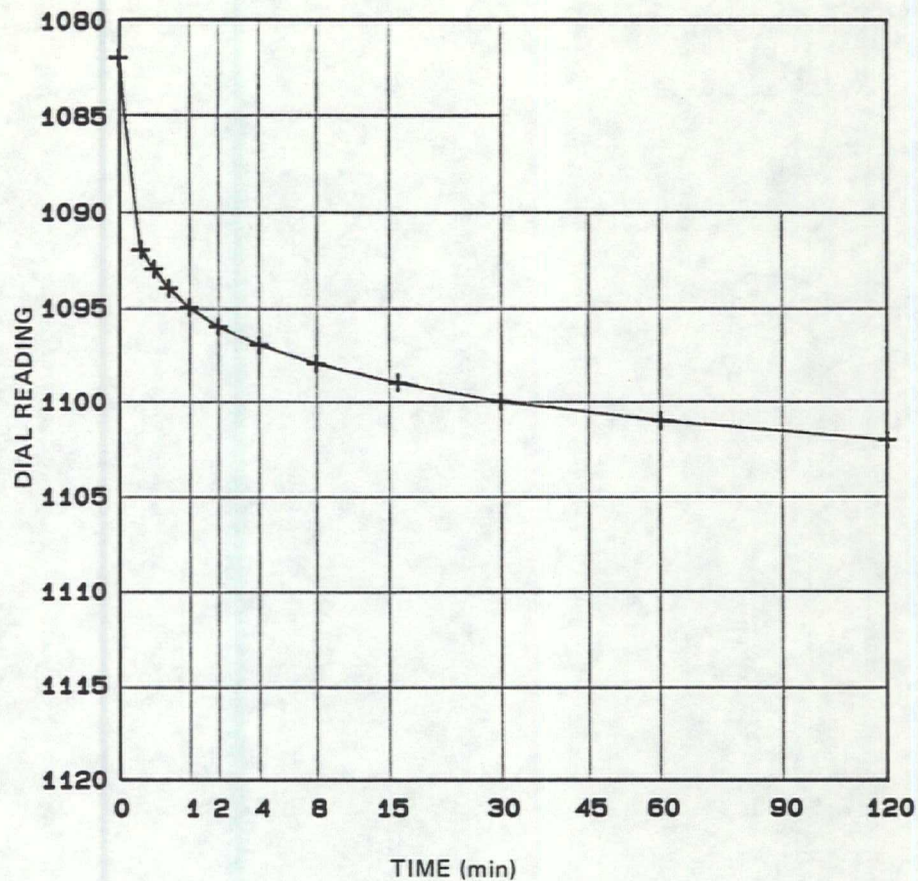
DATE

BORING: CELL B

DEPTH: 0.0 ft.

PRESSURE: 2116 psf

TIME (min)	READING (div)
0.00	1082
0.10	1092
0.25	1093
0.50	1094
1.00	1095
2.00	1096
4.00	1097
8.00	1098
16.00	1099
30.00	1100
60.00	1101
120.00	1102
240.00	1103
480.00	1104
1440.00	1105



Reference: ASTM D-2435



Harding Lawson Associates
Engineers and Geoscientists

Consolidation Test - Time Curve Report

Stabilized P C Sludge Landfill
Northwestern - Sterling, Illinois

DRAWN

JOB NUMBER
20480.031.23

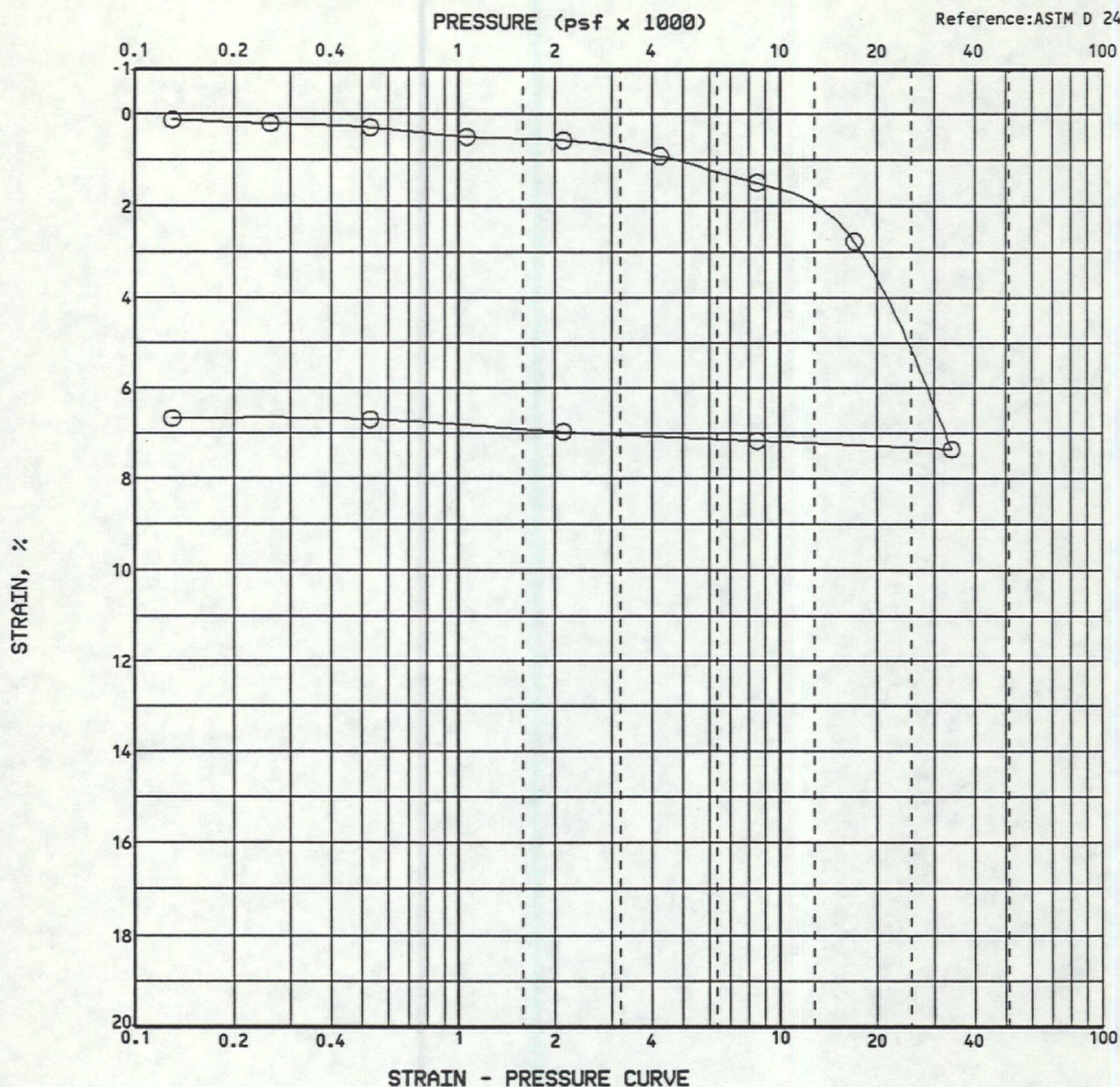
APPROVED
VAB

DATE
08-20-1991

REVISED

DATE

00782/D:



Type of Specimen		Condition		Before Test		After Test	
Diameter(mm)	61.7	Height(mm)	20.3	Water Content	w_o 21.5 %	w_f	30.3 %
Overburden Press., P_o	—	psf		Void Ratio	e_o 1.361	e_f	1.203
Preconsol. Press., P_c	15,000	psf		Saturation	s_o 58 %	s_f	100 %
Compression Ratio, C_{ec}	0.37			Dry Density	d 97 pcf	d	104 pcf
LL	NP	PL	NP	PI	NP	G_s	3.67
Classification: BROWN SILT (ML): Stabilized K061					Source CELL B at 0.0'		



Harding Lawson Associates
Engineering and Environmental Services

Consolidation Test Report

Stabilized P C Sludge Landfill
Northwestern - Sterling, Illinois

DRAWN
HK

JOB NUMBER
20480,031.23

APPROVED
TMB

DATE
11/91

REVISED

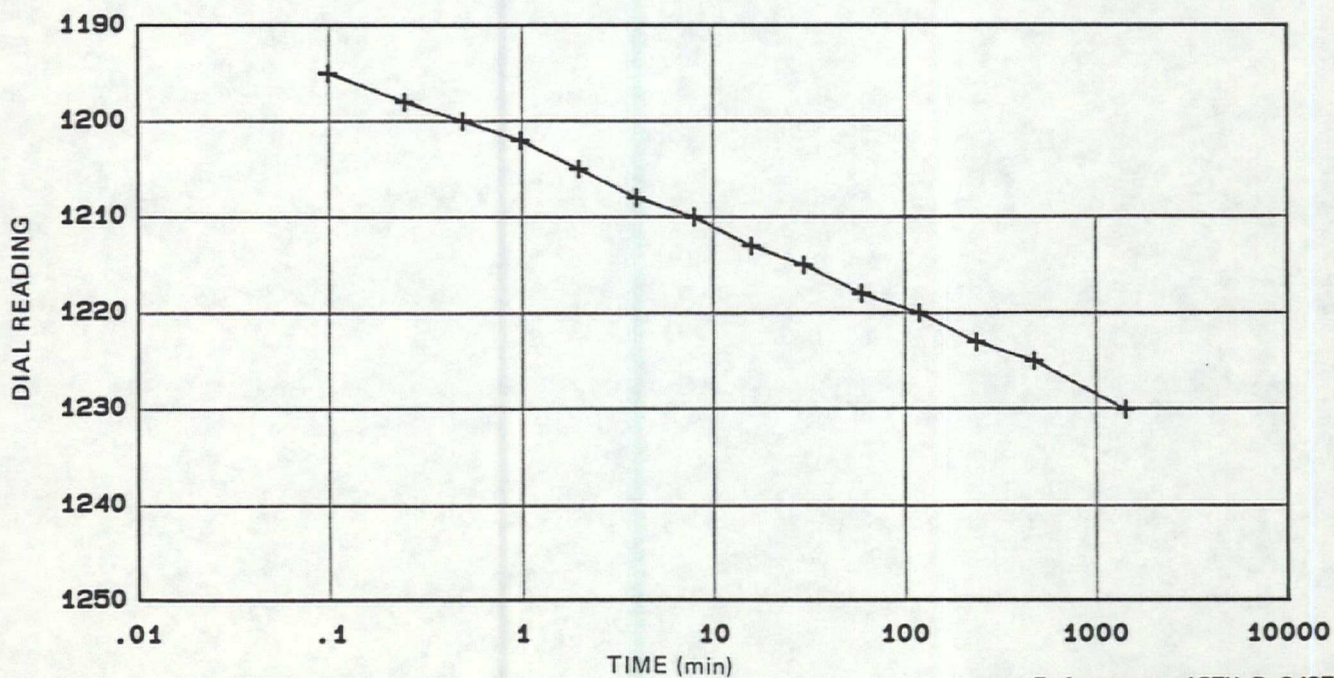
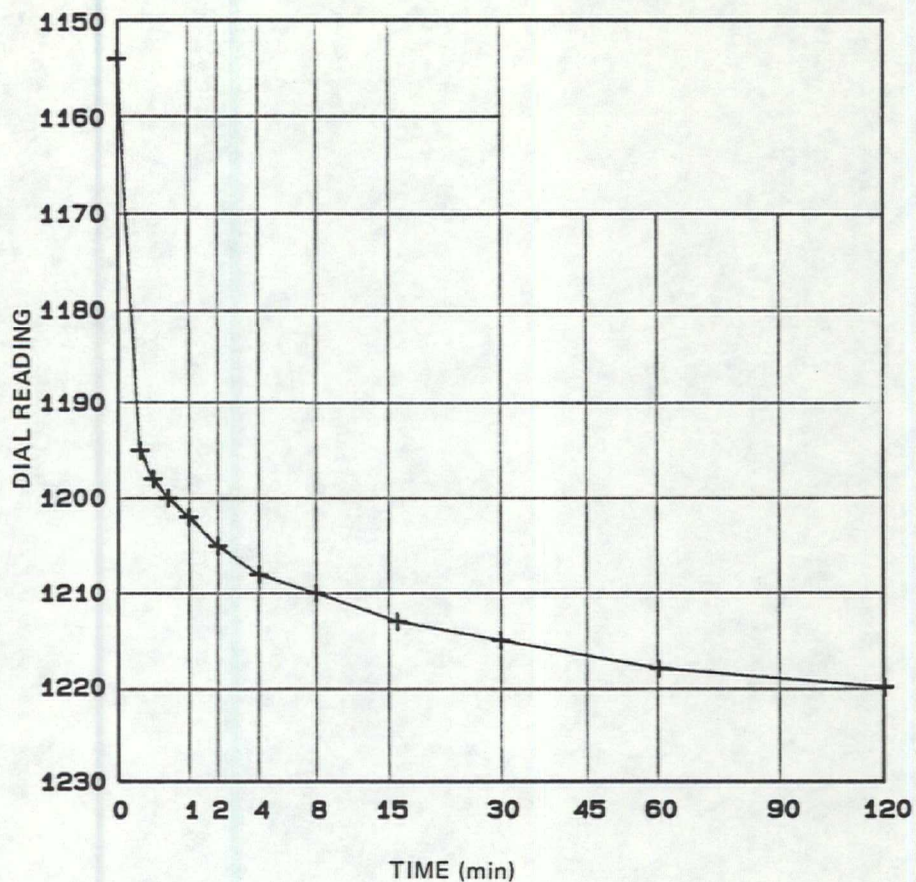
DATE

BORING: CELL B

DEPTH: 0.0 ft.

PRESSURE: 8464 psf

TIME (min)	READING (div)
0.00	1154
0.10	1195
0.25	1198
0.50	1200
1.00	1202
2.00	1205
4.00	1208
8.00	1210
16.00	1213
30.00	1215
60.00	1218
120.00	1220
240.00	1223
480.00	1225
1440.00	1230



Reference: ASTM D-2435



Harding Lawson Associates
Engineers and Geoscientists

Consolidation Test - Time Curve Report

Stabilized P C Sludge Landfill
Northwestern - Sterling, Illinois

DRAWN

JOB NUMBER
20480.031.23

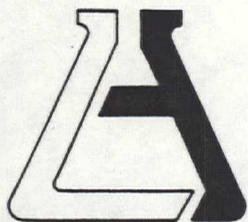
APPROVED

DATE

08-20-1991

REVISED

DATE



ASSOCIATED LABORATORIES

806 North Batavia - Orange, California 92668 - 714/771-6900

FAX 714/538-1209

CLIENT

Harding Lawson Assoc.
Attn: Larry Ward
1712 Newport Circle
Suite F
Santa Ana, CA 92705

(1860) LAB NO. G19767
REPORTED 11/18/91

SAMPLE

Soil
Job #20480,031.21

RECEIVED 11/13/91

IDENTIFICATION

Project Name: N.W. Steel
Cell-B @ 0.0; 09/12/91 @ 1530
As Submitted

BASED ON SAMPLE

Chloride, Soluble

355 mg/kg

Minimum Resistivity
(Calif. Method 643-B-4)

290 ohm-cm

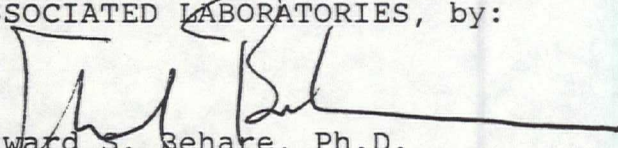
pH

12.28

Sulfate, Soluble

0.15 %

ASSOCIATED LABORATORIES, by:


Edward S. Behare, Ph.D.
Vice President

ESB/ql

NOTE: Unless notified in writing, all samples will be discarded
by appropriate disposal protocol 30 days from date reported.

APPENDIX B

**LINER SPECIFICATIONS AND
PERMEABILITY CALCULATIONS**

315-63

**WASTE TREATMENT FACILITIES
FOR
BEEF ABATTOIR
STERLING, ILLINOIS**

Armour and Company

Chicago, Illinois

1963

APPROVED

Permit # **1963-67-210**
Dated **6-28-63**

Illinois Sanitary Water Board

C. W. Krasen, Tech. Secy.

by **R. L. Evans**

630455

KIRKHAM, MICHAEL & ASSOCIATES
engineers architects

c. Lagoon Excavation and Backfilling

(1) General - The vegetation within the area to be excavated or filled shall be stripped of all vegetation and disposed of as directed by the Engineer. It is the intent of these specifications to have the lagoons constructed in such a manner as to reduce the percolation to less than 1/4 inch per 24 hours with an average operating depth of 5.0 feet. Accordingly, two separate methods for sealing the lagoons are specified and the Contractor may bid either method or both. Regardless of the method utilized, the cohesive material, overlying the non-cohesive material, shall be carefully stockpiled and placed in the excavated and filled areas below the maximum operating depth to achieve a thickness of cohesive material of not less than 8 inches.

(2) Method A - Under Method A the Contractor shall be required to compact the top 12 inches of cohesive soil in fill and cut areas below the maximum operating levels to 95 per cent of maximum density at optimum moisture following the requirements of ASTM Designation 1557-58T (Method A). In all other fill areas 85 per cent of maximum density at optimum moisture will be adequate. The moisture content shall be adjusted to not more than 4 per cent above or 2 per cent below optimum moisture.

(3) Method B - Under Method B the Contractor shall utilize bentonite to aid in sealing the lagoons. Spread one pound of bentonite per square foot on the soil in the lagoons below the maximum operating level. This mixture shall then be scarified or disced to form a loose layer of dry, fine material of 0.50-foot thickness. The resulting mixture of soil and bentonite shall be moistened and compacted with a smooth roller to a density of 90 per cent of maximum density at optimum moisture following the requirements of ASTM Designation D697-58T (Method A). In all other fill areas, 90 per cent of maximum density at optimum moisture will be adequate. The moisture content shall be adjusted to not more than 4 per cent above or 2 per cent below optimum moisture.

d. Seeding and Mulching - Both sides and the top of the dikes around the lagoons shall be seeded to within two feet (Measured along the slope) of the maximum operating level. The seeding shall conform to the requirements of Standard Specification T-2, "Seeding - Type II" except that the seed mixture and the rate of application shall be as follows:

April 8, 1982

Mr. Dale R. VanDeVelde
Northwestern Steel & Wire Co.
121 Wallace St.
Sterling, IL 61081

Re: Hazardous Waste Landfill
Plant No. 6
P.O. No. R264-982

Dear Mr. VanDeVelde:

As you requested, I have made calculations to determine the coefficient of permeability of the soil necessary to satisfy the specification requirements at the time the ponds at your Plant No. 6 were built. These ponds were built by Armour and Company for liquid waste disposal but are now being used for disposal of solids collected from your air pollution control equipment.

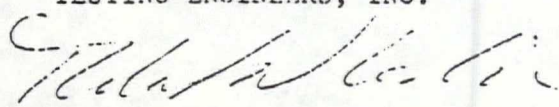
It is understood that the original construction specifications required that the ponds be lined in one of two ways. Method A required the construction of a 12 inch thick liner of cohesive soil compacted to at least 95% of Modified Proctor density. Method B required a 6 inch thick liner of soil mixed with bentonite at the rate of one pound per square foot. This liner was to be compacted to a minimum of 90% of Standard Proctor density. Regardless of which method was used, leakage could not exceed 1/4 inch per day under a 5 foot head of water.

Applying Darcy's Law and assuming that the minimum requirements were satisfied, the coefficient of permeability of the 12 inch liner would have had to be 1.5×10^{-6} centimeters per second. If Method B was used, a permeability coefficient of 7.5×10^{-7} cm./sec. would be required to meet the maximum leakage requirement.

If you have any comments or questions or if you need anything further in this regard, please contact us.

Respectfully submitted,

TESTING ENGINEERS, INC.


Robert N. Leslie, P.E.

RNL/cm

APPENDIX L

APPENDIX C
SLOPE STABILITY CALCULATIONS

NSW Landfill

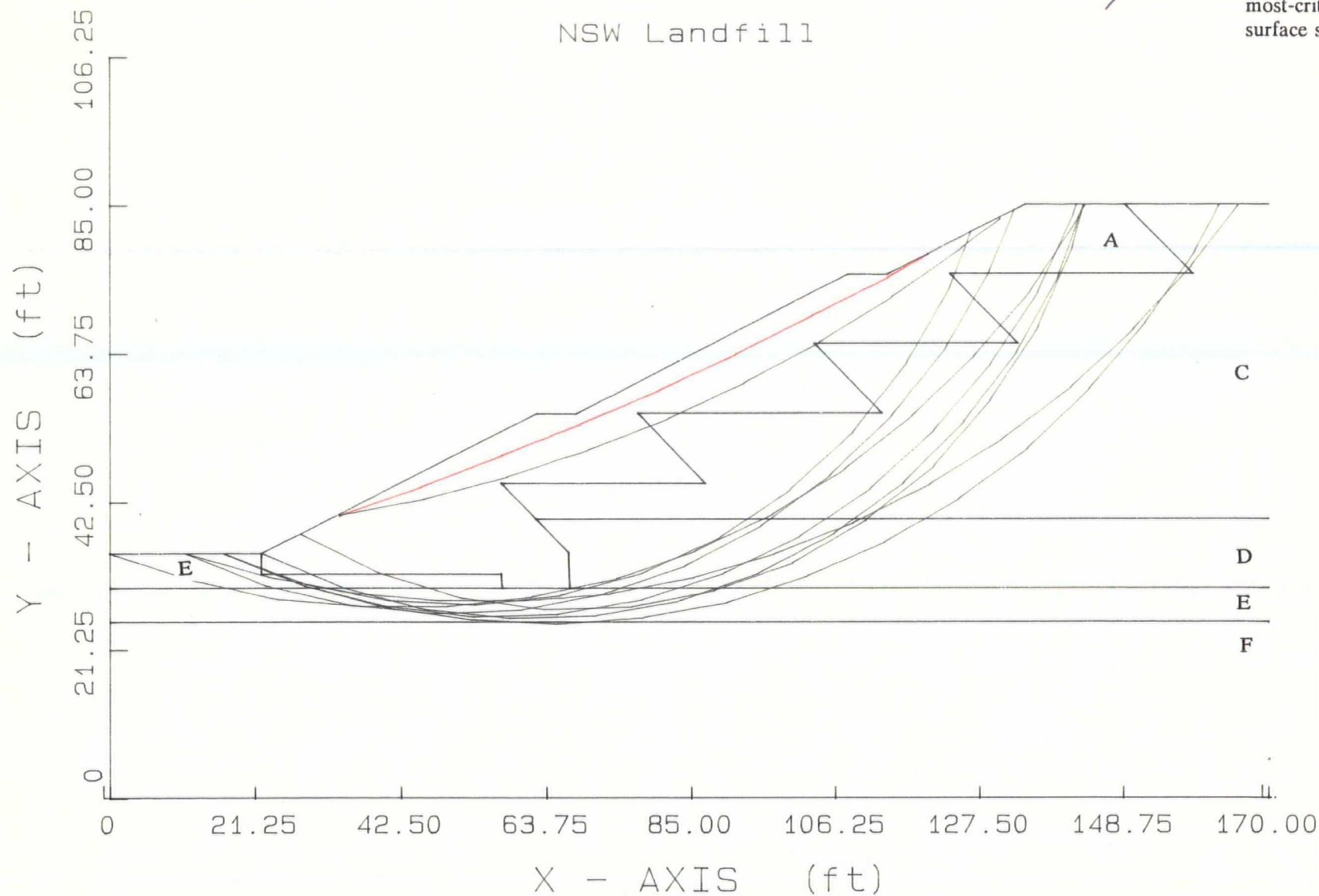
KEY

A

Soil type (See Table C1)



One of ten most-critical trial failure surface, most-critical trial failure surface shown in red.



** PCSTABL5M **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 12/4/91
Time of Run: 11:50
Run By: sah
Input Data Filename: nsw9a2.dat
Output Filename: nsw9a2.out
Plotted Output Filename: nsw9a2.plt

PROBLEM DESCRIPTION NSW LANDFILL

BOUNDARY COORDINATES

8 Top Boundaries
27 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right Below Bnd	Soil Type
1	.00	35.00	22.00	35.00	4
2	22.00	35.00	62.00	55.00	1
3	62.00	55.00	68.00	55.00	1
4	68.00	55.00	108.00	75.00	1
5	108.00	75.00	114.00	75.00	1
6	114.00	75.00	134.00	85.00	1
7	134.00	85.00	149.00	85.00	1
8	149.00	85.00	170.00	85.00	2
9	149.00	85.00	159.00	75.00	1
10	123.00	75.00	159.00	75.00	2
11	123.00	75.00	133.00	65.00	1
12	103.00	65.00	133.00	65.00	2
13	103.00	65.00	113.00	55.00	1
14	77.00	55.00	113.00	55.00	2
15	77.00	55.00	87.00	45.00	1
16	57.00	45.00	87.00	45.00	2
17	57.00	45.00	62.00	40.00	1
18	62.00	40.00	170.00	40.00	3
19	62.00	40.00	67.00	35.00	1
20	67.00	35.00	67.10	30.00	1
21	57.10	30.00	67.10	30.00	5
22	57.00	32.00	57.10	30.00	4
23	22.10	32.00	57.00	32.00	4
24	22.00	35.00	22.10	32.00	4
25	.00	30.00	57.10	30.00	5
26	67.10	30.00	170.00	30.00	5
27	.00	25.00	170.00	25.00	6

ISOTROPIC SOIL PARAMETERS

6 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	35.0	.00	.0	1
2	128.0	135.0	2000.0	.0	.00	.0	1
3	115.0	135.0	1500.0	.0	.00	.0	1
4	118.0	135.0	1000.0	.0	.00	.0	1
5	118.0	135.0	1000.0	.0	.00	.0	1
6	105.0	120.0	.0	35.0	.00	.0	1

1

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	.00	170.00	.00

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

Janbus Empirical Coef. is being used for the case of c & ϕ both > 0
100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between $X = .00$ ft.
and $X = 50.00$ ft.

Each Surface Terminates Between $X = 115.00$ ft.
and $X = 170.00$ ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is $Y = .00$ ft.

12.50 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	33.33	40.67
2	45.17	44.70
3	56.90	49.01
4	68.52	53.60
5	80.04	58.47
6	91.43	63.60
7	102.71	69.01
8	113.84	74.68
9	119.91	77.96

*** 1.642 ***

Individual data on the 12 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force		Tie Force		Earthquake Force		Surcharge	Load
			Top Lbs(kg)	Bot Lbs(kg)	Norm Lbs(kg)	Tan Lbs(kg)	Hor Lbs(kg)	Ver Lbs(kg)		
1	11.8	1447.9	.0	.0	.0	.0	.0	.0	.0	.0
2	11.7	4056.1	.0	.0	.0	.0	.0	.0	.0	.0
3	5.1	2457.1	.0	.0	.0	.0	.0	.0	.0	.0
4	6.0	2175.0	.0	.0	.0	.0	.0	.0	.0	.0
5	.5	111.2	.0	.0	.0	.0	.0	.0	.0	.0
6	11.5	3151.6	.0	.0	.0	.0	.0	.0	.0	.0
7	11.4	4195.7	.0	.0	.0	.0	.0	.0	.0	.0
8	11.3	4728.6	.0	.0	.0	.0	.0	.0	.0	.0
9	5.3	2283.6	.0	.0	.0	.0	.0	.0	.0	.0
10	5.8	1371.6	.0	.0	.0	.0	.0	.0	.0	.0
11	.2	5.6	.0	.0	.0	.0	.0	.0	.0	.0
12	5.9	89.7	.0	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.22	35.11
2	33.71	30.19
3	45.80	27.00
4	58.22	25.61
5	70.72	26.04
6	83.01	28.28
7	94.85	32.30
8	105.98	37.99
9	116.15	45.25
10	125.17	53.91
11	132.82	63.80
12	138.95	74.69
13	142.90	85.00

*** 1.723 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	16.67	35.00
2	28.28	30.36
3	40.41	27.36
4	52.84	26.03
5	65.33	26.41
6	77.66	28.50
7	89.58	32.24
8	100.89	37.58
9	111.36	44.41
10	120.80	52.60
11	129.03	62.00
12	135.91	72.44
13	141.30	83.72
14	141.71	85.00

*** 1.797 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	27.78	37.89
2	38.99	32.37
3	50.95	28.72
4	63.33	27.03
5	75.83	27.34
6	88.12	29.65
7	99.87	33.89
8	110.80	39.96
9	120.62	47.70
10	129.07	56.91
11	135.93	67.36
12	141.04	78.77
13	142.70	85.00

*** 1.811 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	16.67	35.00
2	28.32	30.47
3	40.40	27.27
4	52.76	25.41
5	65.25	24.94
6	77.72	25.86
7	90.01	28.14
8	101.97	31.78
9	113.45	36.71
10	124.32	42.89
11	134.44	50.23
12	143.68	58.65
13	151.94	68.03
14	159.10	78.28
15	162.77	85.00

*** 1.823 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	11.11	35.00
2	22.76	30.45
3	34.92	27.58
4	47.37	26.43
5	59.85	27.04
6	72.13	29.38
7	83.96	33.42
8	95.11	39.08
9	105.36	46.23
10	114.51	54.75
11	122.37	64.46
12	128.80	75.18
13	132.68	84.34

*** 1.942 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	16.67	35.00
2	28.39	30.67
3	40.65	28.20
4	53.13	27.65
5	65.56	29.03
6	77.62	32.32
7	89.03	37.42
8	99.51	44.23
9	108.81	52.58
10	116.72	62.26
11	123.04	73.05
12	126.21	81.10

*** 1.966 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	33.33	40.67
2	45.61	43.01
3	57.73	46.08
4	69.65	49.85
5	81.32	54.33
6	92.71	59.48
7	103.77	65.29
8	114.47	71.75
9	124.78	78.83
10	130.38	83.19

*** 1.998 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	11.11	35.00
2	23.15	31.64
3	35.44	29.38
4	47.89	28.25
5	60.39	28.25
6	72.84	29.38
7	85.14	31.65
8	97.17	35.02
9	108.85	39.46
10	120.08	44.95
11	130.77	51.44
12	140.82	58.87
13	150.16	67.18
14	158.70	76.30
15	165.47	85.00

*** 2.015 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	.00	35.00
2	11.89	31.14
3	24.12	28.57
4	36.56	27.32
5	49.06	27.40
6	61.48	28.80
7	73.68	31.53
8	85.52	35.53
9	96.87	40.77
10	107.59	47.19
11	117.58	54.72
12	126.70	63.26
13	134.86	72.73
14	141.97	83.01
15	143.05	85.00

*** 2.034 ***

Y A X I S F T

.00 21.25 42.50 63.75 85.00 106.25

X .00 L-----+*-*-*---+-----+-----+-----+

-
-
- .06
- ..
- .3
21.25 + 6**2
- .0.9
- . . 3 . 4
- 1
- 62 ..
- .. 3.4....

A 42.50 +
- 6281.
- 94
- 37
- 2.**.....*81
- 60.

X 63.75 + 34* *
- *1*
- 2 6.....8
- 490.....
- 53.7 *
- 2.....8 1

I 85.00 + 960
- 543..7. *...
- 8 1
- 29 60.....
- 4.3..7
- 5*1

S 106.25 + 2 6..... *
- 4.3..7.....
- 5.*8*
- 2..0 7.....
- 94 3.1
- 5..2.. 6..7*8.

127.50 + 4 30. .6 7

-	..... 9 ... ..86
-	... ..5.....2*4.3...*
-	..... ..2 ..
-	.... ..9.....4.32
-	... ..5.
F 148.75 +	.... ..9 .. *
-	. ....5.....
-
-	. ....*95...
-	.... ..5
-	. ....9
T 170.00 L	** * ..*

NSW Landfill Seismic Loading

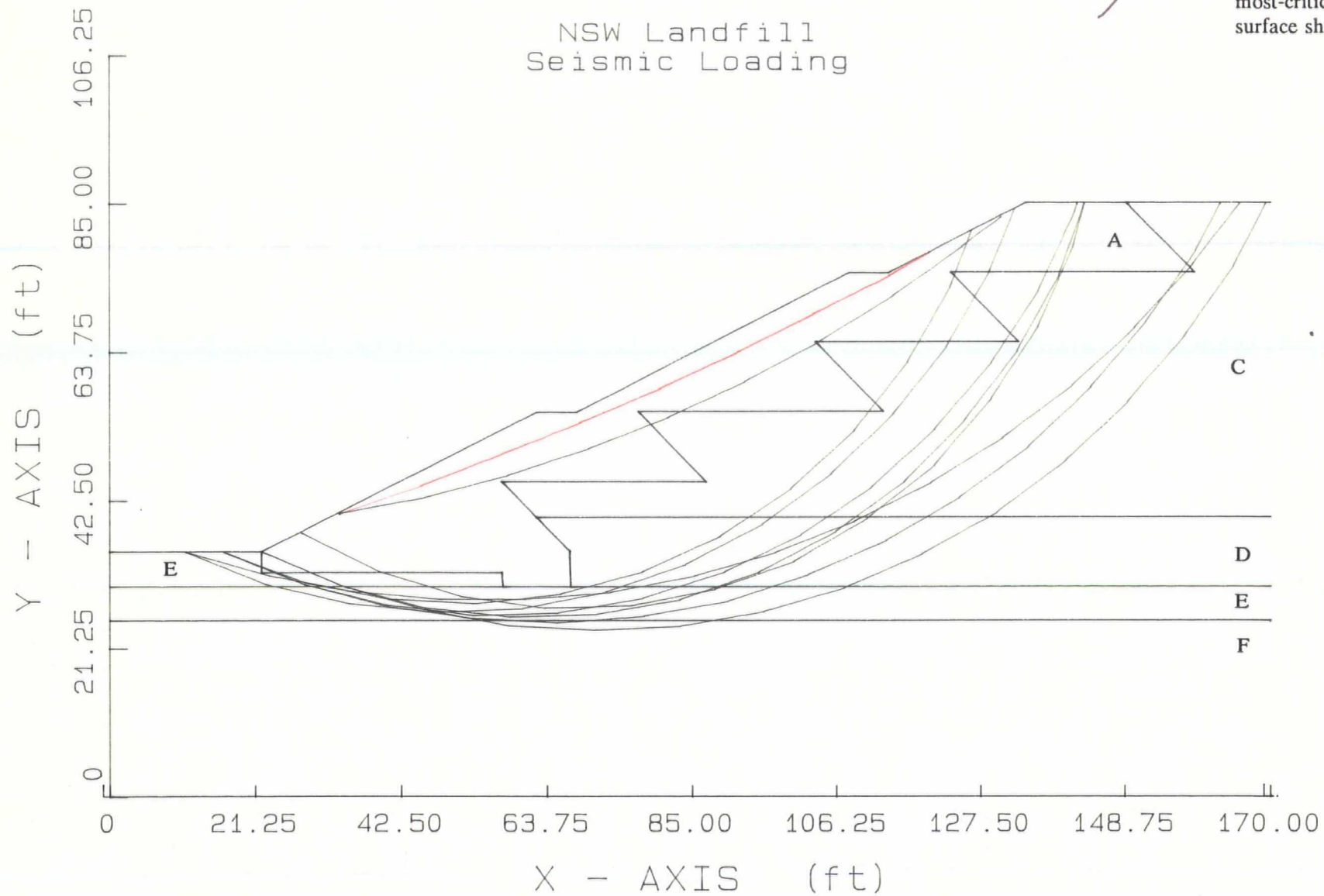
KEY

A

Soil type (See Table C1)



One of ten most-critical
trial failure surface,
most-critical trial failure
surface shown in red.



1

*** PCSTABL5M ***

by
Purdue University

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 12/4/91
Time of Run: 2:30
Run By: sah
Input Data Filename: nsw9b2.dat
Output Filename: nsw9b2.out
Plotted Output Filename: nsw9b2.plt

PROBLEM DESCRIPTION NSW LANDFILL - SEISMIC LOADING

BOUNDARY COORDINATES

8 Top Boundaries
27 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right Below Bnd	Soil Type
1	.00	35.00	22.00	35.00	4
2	22.00	35.00	62.00	55.00	1
3	62.00	55.00	68.00	55.00	1
4	68.00	55.00	108.00	75.00	1
5	108.00	75.00	114.00	75.00	1
6	114.00	75.00	134.00	85.00	1
7	134.00	85.00	149.00	85.00	1
8	149.00	85.00	170.00	85.00	2
9	149.00	85.00	159.00	75.00	1
10	123.00	75.00	159.00	75.00	2
11	123.00	75.00	133.00	65.00	1
12	103.00	65.00	133.00	65.00	2
13	103.00	65.00	113.00	55.00	1
14	77.00	55.00	113.00	55.00	2
15	77.00	55.00	87.00	45.00	1
16	57.00	45.00	87.00	45.00	2
17	57.00	45.00	62.00	40.00	1
18	62.00	40.00	170.00	40.00	3
19	62.00	40.00	67.00	35.00	1
20	67.00	35.00	67.10	30.00	1
21	57.10	30.00	67.10	30.00	5
22	57.00	32.00	57.10	30.00	4
23	22.10	32.00	57.00	32.00	4
24	22.00	35.00	22.10	32.00	4
25	.00	30.00	57.10	30.00	5
26	67.10	30.00	170.00	30.00	5
27	.00	25.00	170.00	25.00	6

1

ISOTROPIC SOIL PARAMETERS

6 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param. (psf)	Piez. Pressure Constant Surface No.
1	130.0	140.0	.0	35.0	.00	.0 1
2	128.0	135.0	2000.0	.0	.00	.0 1
3	115.0	135.0	1500.0	.0	.00	.0 1
4	118.0	135.0	1000.0	.0	.00	.0 1
5	118.0	135.0	1000.0	.0	.00	.0 1
6	105.0	120.0	.0	35.0	.00	.0 1

A Horizontal Earthquake Loading Coefficient
Of .050 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of .005 Has Been Assigned

Cavitation Pressure = .0 psf

1

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	.00	170.00	.00

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

Janbus Empirical Coef. is being used for the case of c & ϕ both > 0
100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between $X = .00$ ft.
and $X = 50.00$ ft.

Each Surface Terminates Between $X = 115.00$ ft.
and $X = 170.00$ ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is $Y = .00$ ft.

12.50 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

** Safety Factors Are Calculated By The Modified Janbu Method **

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	33.33	40.67
2	45.17	44.70
3	56.90	49.01
4	68.52	53.60
5	80.04	58.47
6	91.43	63.60
7	102.71	69.01
8	113.84	74.68
9	119.91	77.96

*** 1.440 ***

Individual data on the 12 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force		Tie Force		Earthquake Force		Surcharge	
			Top Lbs(kg)	Bot Lbs(kg)	Norm Lbs(kg)	Tan Lbs(kg)	Hor Lbs(kg)	Ver Lbs(kg)	Load Lbs(kg)	
1	11.8	1447.9	.0	.0	.0	.0	72.4	7.2	.0	
2	11.7	4056.1	.0	.0	.0	.0	202.8	20.3	.0	
3	5.1	2457.1	.0	.0	.0	.0	122.9	12.3	.0	
4	6.0	2175.0	.0	.0	.0	.0	108.8	10.9	.0	
5	.5	111.2	.0	.0	.0	.0	5.6	.6	.0	
6	11.5	3151.6	.0	.0	.0	.0	157.6	15.8	.0	
7	11.4	4195.7	.0	.0	.0	.0	209.8	21.0	.0	
8	11.3	4728.6	.0	.0	.0	.0	236.4	23.6	.0	
9	5.3	2283.6	.0	.0	.0	.0	114.2	11.4	.0	
10	5.8	1371.6	.0	.0	.0	.0	68.6	6.9	.0	
11	.2	5.6	.0	.0	.0	.0	.3	.0	.0	
12	5.9	89.7	.0	.0	.0	.0	4.5	.4	.0	

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.22	35.11
2	33.71	30.19
3	45.80	27.00
4	58.22	25.61
5	70.72	26.04
6	83.01	28.28
7	94.85	32.30
8	105.98	37.99
9	116.15	45.25
10	125.17	53.91
11	132.82	63.80
12	138.95	74.69
13	142.90	85.00

*** 1.547 ***

1

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	16.67	35.00
2	28.28	30.36
3	40.41	27.36
4	52.84	26.03
5	65.33	26.41
6	77.66	28.50
7	89.58	32.24
8	100.89	37.58
9	111.36	44.41
10	120.80	52.60
11	129.03	62.00
12	135.91	72.44
13	141.30	83.72
14	141.71	85.00

*** 1.614 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	16.67	35.00
2	28.32	30.47
3	40.40	27.27
4	52.76	25.41
5	65.25	24.94
6	77.72	25.86
7	90.01	28.14
8	101.97	31.78
9	113.45	36.71
10	124.32	42.89
11	134.44	50.23
12	143.68	58.65
13	151.94	68.03
14	159.10	78.28
15	162.77	85.00

*** 1.615 ***

1

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	27.78	37.89
2	38.99	32.37
3	50.95	28.72
4	63.33	27.03
5	75.83	27.34
6	88.12	29.65
7	99.87	33.89
8	110.80	39.96
9	120.62	47.70
10	129.07	56.91
11	135.93	67.36
12	141.04	78.77
13	142.70	85.00

*** 1.625 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	11.11	35.00
2	22.76	30.45
3	34.92	27.58
4	47.37	26.43
5	59.85	27.04
6	72.13	29.38
7	83.96	33.42
8	95.11	39.08
9	105.36	46.23
10	114.51	54.75
11	122.37	64.46
12	128.80	75.18
13	132.68	84.34

*** 1.745 ***

1

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	33.33	40.67
2	45.61	43.01
3	57.73	46.08
4	69.65	49.85
5	81.32	54.33
6	92.71	59.48
7	103.77	65.29
8	114.47	71.75
9	124.78	78.83
10	130.38	83.19

*** 1.764 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	16.67	35.00
2	28.39	30.67
3	40.65	28.20
4	53.13	27.65
5	65.56	29.03
6	77.62	32.32
7	89.03	37.42
8	99.51	44.23
9	108.81	52.58
10	116.72	62.26
11	123.04	73.05
12	126.21	81.10

*** 1.766 ***

1

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	11.11	35.00
2	23.15	31.64
3	35.44	29.38
4	47.89	28.25
5	60.39	28.25
6	72.84	29.38
7	85.14	31.65
8	97.17	35.02
9	108.85	39.46
10	120.08	44.95
11	130.77	51.44
12	140.82	58.87
13	150.16	67.18
14	158.70	76.30
15	165.47	85.00

*** 1.783 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.22	35.11
2	33.73	30.24
3	45.72	26.69
4	58.03	24.54
5	70.51	23.78
6	82.99	24.45
7	95.32	26.53
8	107.33	29.99
9	118.87	34.79
10	129.80	40.86
11	139.96	48.14
12	149.24	56.51
13	157.51	65.89
14	164.66	76.14
15	169.45	85.00

*** 1.801 ***

Y A X I S F T

.00 21.25 42.50 63.75 85.00 106.25

X .00 L-----+***+-----+-----+-----+

-
-
- . .
-6

-
- . .3
21.25 +6**2

- . .9
- . . 3 . 5
- 1
-62 ..
- .. 3.5... .

A 42.50 +
-6271.

-95
-38
- 2.**.....*71
- 6.

X 63.75 +35*
- *. .1*

-02 6.....7
-59.....
- 43.8 *
- 02..... 7 1

I 85.00 +96.
-453..8. *...

- 7 1
-0..29 6.....
-5.3..8.
- 4*1

S 106.25 +0.. 2 6..... *

-5.3..8.....
- 4. . . * .. 7*
-2 . . 8.....
-0..95 3.1

127.50 + 5 3.. .6 8
-0.. 976

-4.....2*5.3...*
-2 ..
-0.. 9.....5.32
-4.

F 148.75 +0....9 .. *


-4.....
-0
- *94...
-0..4
-9

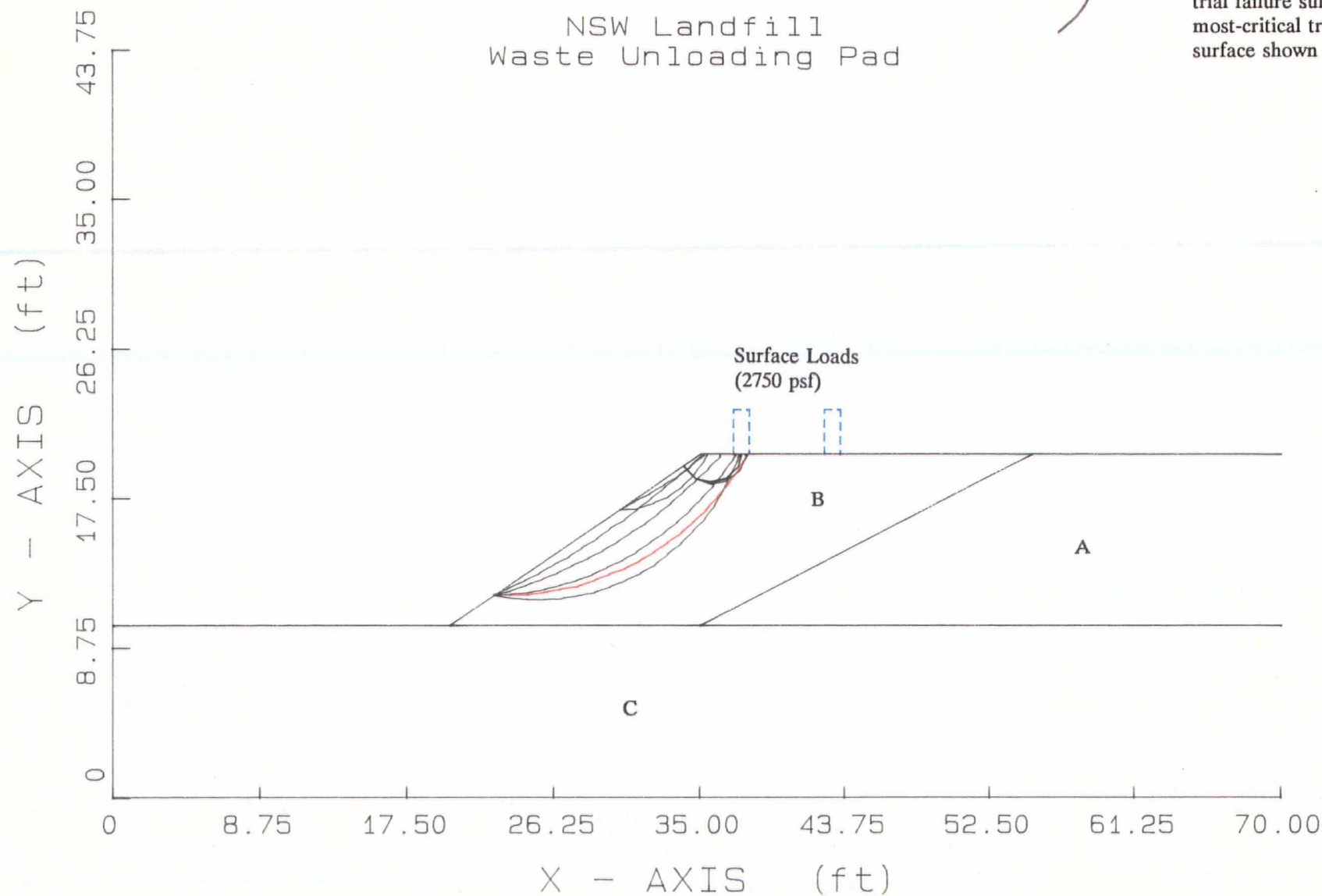
T 170.00 L

* * *

...*

NSW Landfill Waste Unloading Pad

KEY	
A	Soil type (See Table C1)
	One of ten most-critical trial failure surface, most-critical trial failure surface shown in red.



**** PCSTABL5M ****

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 12/5/91
Time of Run: 4:15
Run By: sah
Input Data Filename: nswwup
Output Filename: nswwup.out
Plotted Output Filename: nswwup.plt

PROBLEM DESCRIPTION NSW LANDFILL - WASTE UNLOADING PAD

BOUNDARY COORDINATES

4 Top Boundaries
7 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right Below Bnd	Soil Type
1	.00	10.00	20.00	10.00	3
2	20.00	10.00	35.00	20.00	1
3	35.00	20.00	55.00	20.00	1
4	55.00	20.00	70.00	20.00	2
5	35.00	10.00	55.00	20.00	2
6	20.00	10.00	35.00	10.00	3
7	35.00	10.00	70.00	10.00	3

1

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	140.0	145.0	.0	45.0	.00	.0	1
2	130.0	140.0	.0	35.0	.00	.0	1
3	128.0	135.0	2000.0	.0	.00	.0	1

1

BOUNDARY LOAD(S)

2 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (lb/sqft)	Deflection (deg)
1	37.00	38.00	2750.0	.0
2	42.50	43.50	2750.0	.0

NOTE - Intensity Is Specified As A Uniformly Distributed Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

Janbus Empirical Coef. is being used for the case of c & ϕ both > 0
100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between $X = .00$ ft.
and $X = 34.00$ ft.

Each Surface Terminates Between $X = 35.00$ ft.
and $X = 45.00$ ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is $Y = .00$ ft.

1.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.67	11.78
2	23.67	11.78
3	24.67	11.84
4	25.66	11.96
5	26.64	12.13
6	27.62	12.36
7	28.57	12.65
8	29.51	13.00
9	30.43	13.39
10	31.32	13.84
11	32.19	14.34
12	33.03	14.89
13	33.83	15.49
14	34.59	16.13
15	35.32	16.82
16	36.01	17.54
17	36.65	18.31
18	37.25	19.11
19	37.80	19.95
20	37.83	20.00

*** 1.445 ***

Individual data on the 21 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force		Tie Force		Earthquake Force		Surcharge		Load Lbs(kg)
			Top Lbs(kg)	Bot Lbs(kg)	Norm Lbs(kg)	Tan Lbs(kg)	Hor Lbs(kg)	Ver Lbs(kg)			
1	1.0	46.5	.0	.0	.0	.0	.0	.0	.0	.0	
2	1.0	135.2	.0	.0	.0	.0	.0	.0	.0	.0	
3	1.0	214.5	.0	.0	.0	.0	.0	.0	.0	.0	
4	1.0	283.3	.0	.0	.0	.0	.0	.0	.0	.0	
5	1.0	341.1	.0	.0	.0	.0	.0	.0	.0	.0	
6	1.0	387.2	.0	.0	.0	.0	.0	.0	.0	.0	
7	.9	421.5	.0	.0	.0	.0	.0	.0	.0	.0	
8	.9	443.9	.0	.0	.0	.0	.0	.0	.0	.0	
9	.9	454.7	.0	.0	.0	.0	.0	.0	.0	.0	
10	.9	454.2	.0	.0	.0	.0	.0	.0	.0	.0	
11	.8	443.1	.0	.0	.0	.0	.0	.0	.0	.0	
12	.8	422.4	.0	.0	.0	.0	.0	.0	.0	.0	
13	.8	393.0	.0	.0	.0	.0	.0	.0	.0	.0	
14	.4	201.5	.0	.0	.0	.0	.0	.0	.0	.0	
15	.3	150.0	.0	.0	.0	.0	.0	.0	.0	.0	
16	.7	271.0	.0	.0	.0	.0	.0	.0	.0	.0	
17	.6	186.7	.0	.0	.0	.0	.0	.0	.0	.0	
18	.3	71.1	.0	.0	.0	.0	.0	.0	.0	.0	
19	.2	36.8	.0	.0	.0	.0	.0	.0	.0	685.1	
20	.6	36.3	.0	.0	.0	.0	.0	.0	.0	1513.6	
21	.0	.1	.0	.0	.0	.0	.0	.0	.0	86.1	

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	34.00	19.33
2	34.75	18.68
3	35.73	18.46
4	36.69	18.74
5	37.40	19.45
6	37.56	20.00

*** 1.514 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	34.00	19.33
2	34.71	18.63
3	35.66	18.33
4	36.65	18.51
5	37.44	19.12
6	37.85	20.00

*** 1.531 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.67	11.78
2	23.57	12.21
3	24.46	12.66
4	25.35	13.13
5	26.22	13.61
6	27.08	14.12
7	27.94	14.64
8	28.78	15.17
9	29.62	15.73
10	30.44	16.29
11	31.25	16.88
12	32.05	17.48
13	32.84	18.10
14	33.61	18.73
15	34.38	19.37
16	35.09	20.00

*** 1.536 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.22	16.82
2	31.11	17.28
3	31.97	17.78
4	32.83	18.30
5	33.67	18.85
6	34.49	19.42
7	35.28	20.00

*** 1.566 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	34.00	19.33
2	34.71	18.63
3	35.68	18.39
4	36.64	18.67
5	37.33	19.39
6	37.47	20.00

*** 1.603 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.67	11.78
2	23.66	11.63
3	24.65	11.55
4	25.65	11.56
5	26.65	11.64
6	27.64	11.79
7	28.61	12.02
8	29.57	12.32
9	30.49	12.69
10	31.39	13.14
11	32.25	13.65
12	33.07	14.22
13	33.84	14.85
14	34.56	15.55
15	35.23	16.29
16	35.84	17.08
17	36.39	17.92
18	36.87	18.80
19	37.28	19.71
20	37.39	20.00

*** 1.637 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.67	11.78
2	23.62	12.07
3	24.57	12.39
4	25.51	12.74
5	26.43	13.12
6	27.34	13.54
7	28.24	13.98
8	29.12	14.46
9	29.98	14.96
10	30.83	15.49
11	31.66	16.05
12	32.46	16.64
13	33.25	17.26
14	34.02	17.90
15	34.77	18.57
16	35.49	19.26
17	36.19	19.97
18	36.21	20.00

*** 1.655 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.67	11.78
2	23.66	11.86
3	24.65	12.00
4	25.64	12.19
5	26.61	12.43
6	27.56	12.72
7	28.50	13.07
8	29.42	13.46
9	30.32	13.90
10	31.19	14.39
11	32.04	14.92
12	32.85	15.50
13	33.64	16.12
14	34.39	16.78
15	35.10	17.48
16	35.78	18.22
17	36.41	18.99
18	37.01	19.79
19	37.14	20.00

*** 1.684 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.22	16.82
2	31.22	16.93
3	32.18	17.20
4	33.08	17.62
5	33.91	18.19
6	34.63	18.88
7	35.24	19.67
8	35.41	20.00

*** 1.778 ***

Y A X I S F T

.00 8.75 17.50 26.25 35.00 43.75

X .00 +-----+*-----+-----+-----+

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8.75 +

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A 17.50 +

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X 26.25 +7184

-71844
-11.44
-118845
-719884
-711.842

I 35.00 +*.....11924*

-1198/1
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S 43.75 +2/

-

52.50 +

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F 61.25 +

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T 70.00 + * *

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	140.0	145.0	.0	45.0	.00	.0	1
2	130.0	140.0	.0	35.0	.00	.0	1
3	128.0	135.0	2000.0	.0	.00	.0	1

1

BOUNDARY LOAD(S)

2 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (lb/sqft)	Deflection (deg)
1	37.00	38.00	2750.0	.0
2	42.50	43.50	2750.0	.0

NOTE - Intensity Is Specified As A Uniformly Distributed Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

Janbus Empirical Coef. is being used for the case of c & ϕ both > 0
100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between $X = .00$ ft.
and $X = 34.00$ ft.

Each Surface Terminates Between $X = 35.00$ ft.
and $X = 45.00$ ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is $Y = .00$ ft.

1.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.67	11.78
2	23.67	11.78
3	24.67	11.84
4	25.66	11.96
5	26.64	12.13
6	27.62	12.36
7	28.57	12.65
8	29.51	13.00
9	30.43	13.39
10	31.32	13.84
11	32.19	14.34
12	33.03	14.89
13	33.83	15.49
14	34.59	16.13
15	35.32	16.82
16	36.01	17.54
17	36.65	18.31
18	37.25	19.11
19	37.80	19.95
20	37.83	20.00

*** 1.445 ***

Individual data on the 21 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force		Tie Force		Tie Force		Earthquake Force		Surcharge Ver	Load Lbs(kg)
			Top Lbs(kg)	Bot Lbs(kg)	Norm Lbs(kg)	Tan Lbs(kg)	Hor Lbs(kg)	Ver Lbs(kg)				
1	1.0	46.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	
2	1.0	135.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	
3	1.0	214.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	
4	1.0	283.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	
5	1.0	341.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	
6	1.0	387.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	
7	.9	421.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	
8	.9	443.9	.0	.0	.0	.0	.0	.0	.0	.0	.0	
9	.9	454.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	
10	.9	454.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	
11	.8	443.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	
12	.8	422.4	.0	.0	.0	.0	.0	.0	.0	.0	.0	
13	.8	393.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	
14	.4	201.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	
15	.3	150.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	
16	.7	271.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	
17	.6	186.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	
18	.3	71.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	
19	.2	36.8	.0	.0	.0	.0	.0	.0	.0	.0	685.1	
20	.6	36.3	.0	.0	.0	.0	.0	.0	.0	.0	1513.6	
21	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	86.1	

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	34.00	19.33
2	34.75	18.68
3	35.73	18.46
4	36.69	18.74
5	37.40	19.45
6	37.56	20.00

*** 1.514 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	34.00	19.33
2	34.71	18.63
3	35.66	18.33
4	36.65	18.51
5	37.44	19.12
6	37.85	20.00

*** 1.531 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.67	11.78
2	23.57	12.21
3	24.46	12.66
4	25.35	13.13
5	26.22	13.61
6	27.08	14.12
7	27.94	14.64
8	28.78	15.17
9	29.62	15.73
10	30.44	16.29
11	31.25	16.88
12	32.05	17.48
13	32.84	18.10
14	33.61	18.73
15	34.38	19.37
16	35.09	20.00

*** 1.536 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.22	16.82
2	31.11	17.28
3	31.97	17.78
4	32.83	18.30
5	33.67	18.85
6	34.49	19.42
7	35.28	20.00

*** 1.566 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	34.00	19.33
2	34.71	18.63
3	35.68	18.39
4	36.64	18.67
5	37.33	19.39
6	37.47	20.00

*** 1.603 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.67	11.78
2	23.66	11.63
3	24.65	11.55
4	25.65	11.56
5	26.65	11.64
6	27.64	11.79
7	28.61	12.02
8	29.57	12.32
9	30.49	12.69
10	31.39	13.14
11	32.25	13.65
12	33.07	14.22
13	33.84	14.85
14	34.56	15.55
15	35.23	16.29
16	35.84	17.08
17	36.39	17.92
18	36.87	18.80
19	37.28	19.71
20	37.39	20.00

*** 1.637 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.67	11.78
2	23.62	12.07
3	24.57	12.39
4	25.51	12.74
5	26.43	13.12
6	27.34	13.54
7	28.24	13.98
8	29.12	14.46
9	29.98	14.96
10	30.83	15.49
11	31.66	16.05
12	32.46	16.64
13	33.25	17.26
14	34.02	17.90
15	34.77	18.57
16	35.49	19.26
17	36.19	19.97
18	36.21	20.00

*** 1.655 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.67	11.78
2	23.66	11.86
3	24.65	12.00
4	25.64	12.19
5	26.61	12.43
6	27.56	12.72
7	28.50	13.07
8	29.42	13.46
9	30.32	13.90
10	31.19	14.39
11	32.04	14.92
12	32.85	15.50
13	33.64	16.12
14	34.39	16.78
15	35.10	17.48
16	35.78	18.22
17	36.41	18.99
18	37.01	19.79
19	37.14	20.00

*** 1.684 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.22	16.82
2	31.22	16.93
3	32.18	17.20
4	33.08	17.62
5	33.91	18.19
6	34.63	18.88
7	35.24	19.67
8	35.41	20.00

*** 1.778 ***

Y A X I S F T

.00 8.75 17.50 26.25 35.00 43.75

X .00 +-----+*-----+-----+-----+

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X 26.25 +7184

-71844
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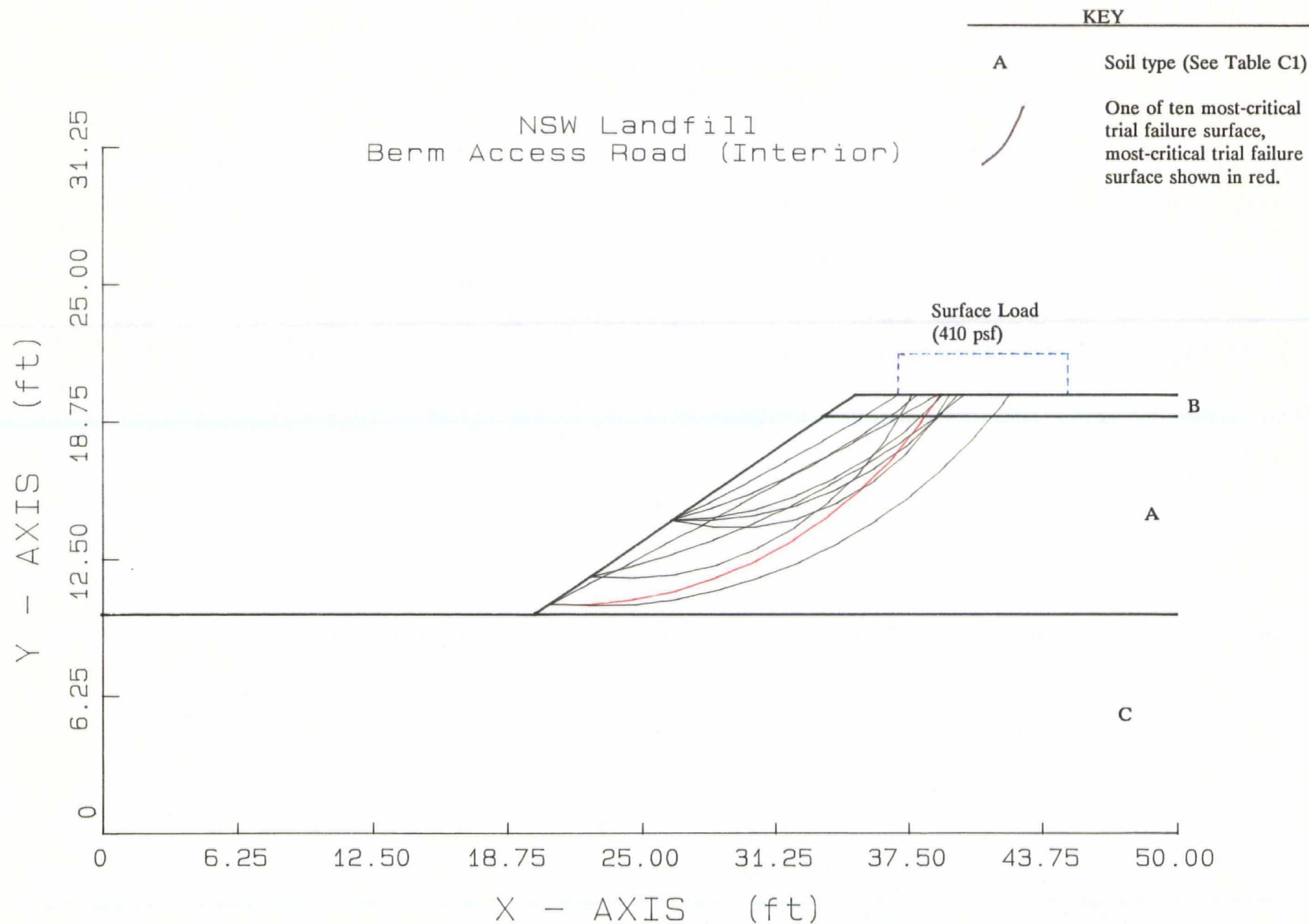
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F 61.25 +

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T 70.00 + * *

NSW Landfill
Berm Access Road (Interior)



**** PCSTABL5M ****

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 12/5/91
Time of Run: 4:10
Run By: sah
Input Data Filename: nswbar2
Output Filename: nswbar2.out
Plotted Output Filename: nswbar2.plt

PROBLEM DESCRIPTION NSW LANDFILL - BERM ACCESS ROAD (INTERIOR)

BOUNDARY COORDINATES

4 Top Boundaries
6 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right Below Bnd	Soil Type
1	.00	10.00	20.00	10.00	3
2	20.00	10.00	33.50	19.00	2
3	33.50	19.00	35.00	20.00	1
4	35.00	20.00	50.00	20.00	1
5	33.50	19.00	50.00	19.00	2
6	20.00	10.00	50.00	10.00	3

1

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param. (psf)	Piez. Pressure Constant (psf)	Surface No.
1	140.0	145.0	.0	45.0	.00	.0	1
2	130.0	140.0	.0	35.0	.00	.0	1
3	128.0	135.0	2000.0	.0	.00	.0	1

1

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (lb/sqft)	Deflection (deg)
1	37.00	45.00	410.0	.0

NOTE - Intensity Is Specified As A Uniformly Distributed Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

Janbus Empirical Coef. is being used for the case of c & ϕ both > 0
100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between $X = 15.00$ ft.
and $X = 32.00$ ft.

Each Surface Terminates Between $X = 37.00$ ft.
and $X = 50.00$ ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is $Y = .00$ ft.

2.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	20.67	10.44
2	22.67	10.46
3	24.66	10.67
4	26.62	11.07
5	28.53	11.66
6	30.38	12.43
7	32.14	13.36
8	33.81	14.47
9	35.36	15.73
10	36.79	17.13
11	38.07	18.66
12	38.99	20.00

*** 1.314 ***

Individual data on the 15 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force		Tie Force		Earthquake Force		Surcharge		Load Lbs(kg)
			Top Lbs(kg)	Bot Lbs(kg)	Norm Lbs(kg)	Tan Lbs(kg)	Hor Lbs(kg)	Ver Lbs(kg)			
1	2.0	170.9	.0	.0	.0	.0	.0	.0	.0	.0	
2	2.0	484.2	.0	.0	.0	.0	.0	.0	.0	.0	
3	2.0	734.7	.0	.0	.0	.0	.0	.0	.0	.0	
4	1.9	915.3	.0	.0	.0	.0	.0	.0	.0	.0	
5	1.8	1022.9	.0	.0	.0	.0	.0	.0	.0	.0	
6	1.8	1058.2	.0	.0	.0	.0	.0	.0	.0	.0	
7	1.4	836.1	.0	.0	.0	.0	.0	.0	.0	.0	
8	.3	190.1	.0	.0	.0	.0	.0	.0	.0	.0	
9	1.2	727.7	.0	.0	.0	.0	.0	.0	.0	.0	
10	.4	211.6	.0	.0	.0	.0	.0	.0	.0	.0	
11	1.4	676.2	.0	.0	.0	.0	.0	.0	.0	.0	
12	.2	77.7	.0	.0	.0	.0	.0	.0	.0	.0	
13	1.1	286.5	.0	.0	.0	.0	.0	.0	.0	440.1	
14	.2	37.4	.0	.0	.0	.0	.0	.0	.0	94.8	
15	.7	48.1	.0	.0	.0	.0	.0	.0	.0	281.6	

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	26.33	14.22
2	28.14	15.09
3	29.92	15.99
4	31.69	16.92
5	33.44	17.89
6	35.18	18.88
7	36.89	19.91
8	37.03	20.00

*** 1.341 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.56	11.70
2	24.55	11.63
3	26.55	11.82
4	28.49	12.27
5	30.37	12.98
6	32.13	13.93
7	33.75	15.09
8	35.20	16.47
9	36.46	18.02
10	37.51	19.73
11	37.63	20.00

*** 1.350 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	26.33	14.22
2	28.25	14.80
3	30.12	15.49
4	31.95	16.30
5	33.73	17.22
6	35.45	18.25
7	37.10	19.38
8	37.89	20.00

*** 1.397 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.56	11.70
2	24.50	12.18
3	26.42	12.74
4	28.31	13.39
5	30.17	14.12
6	31.99	14.94
7	33.78	15.85
8	35.52	16.84
9	37.21	17.90
10	38.85	19.05
11	40.09	20.00

*** 1.403 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	26.33	14.22
2	28.33	14.39
3	30.29	14.78
4	32.20	15.38
5	34.02	16.19
6	35.75	17.20
7	37.36	18.39
8	38.82	19.75
9	39.04	20.00

*** 1.426 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	20.67	10.44
2	22.45	11.35
3	24.23	12.26
4	26.01	13.17
5	27.79	14.09
6	29.56	15.02
7	31.33	15.95
8	33.10	16.88
9	34.86	17.83
10	36.62	18.78
11	38.38	19.73
12	38.87	20.00

*** 1.458 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	26.33	14.22
2	28.33	14.23
3	30.32	14.47
4	32.26	14.96
5	34.12	15.68
6	35.89	16.62
7	37.52	17.77
8	39.01	19.12
9	39.77	20.00

*** 1.479 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	20.67	10.44
2	22.67	10.37
3	24.66	10.45
4	26.65	10.70
5	28.61	11.10
6	30.53	11.67
7	32.39	12.38
8	34.20	13.25
9	35.93	14.25
10	37.57	15.40
11	39.11	16.67
12	40.55	18.06
13	41.87	19.56
14	42.19	20.00

*** 1.480 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	26.33	14.22
2	28.31	13.92
3	30.31	13.96
4	32.28	14.34
5	34.15	15.04
6	35.87	16.05
7	37.41	17.34
8	38.70	18.86
9	39.37	20.00

*** 1.484 ***

Y A X I S F T

.00 6.25 12.50 18.75 25.00 31.25

X .00 +-----+-----*-----+-----+-----+

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X 18.75 +

I 25.00 +

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F 43.75 +

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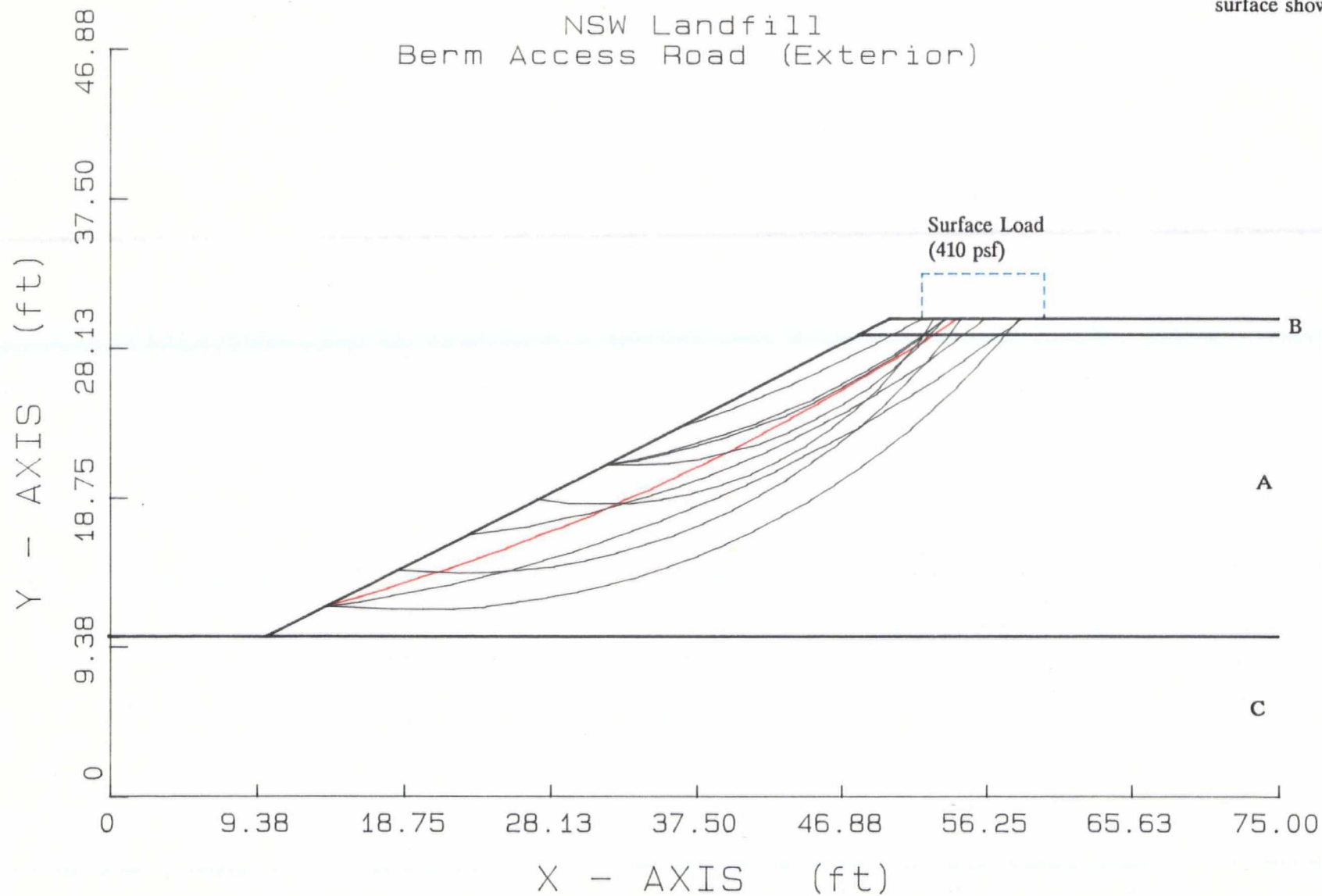
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KEY

A Soil type (See Table C1)

One of ten most-critical trial failure surface, most-critical trial failure surface shown in red.



**** PCSTABL5M ****

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 12/6/91
Time of Run: 8:30
Run By: sah
Input Data Filename: nswextul
Output Filename: nswextul.out
Plotted Output Filename: nswextul.plt

PROBLEM DESCRIPTION NSW LANDFILL - BERM ACCESS ROAD,
EXTERIOR SLOPE, UNIFORM LOAD

BOUNDARY COORDINATES

4 Top Boundaries
6 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right Below Bnd	Soil Type
1	.00	10.00	10.00	10.00	3
2	10.00	10.00	48.00	29.00	2
3	48.00	29.00	50.00	30.00	1
4	50.00	30.00	75.00	30.00	1
5	48.00	29.00	75.00	29.00	2
6	10.00	10.00	75.00	10.00	3

1

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	140.0	145.0	.0	45.0	.00	.0	1
2	130.0	140.0	.0	35.0	.00	.0	1
3	128.0	135.0	2000.0	.0	.00	.0	1

1

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (lb/sqft)	Deflection (deg)
1	37.00	45.00	410.0	.0

NOTE - Intensity Is Specified As A Uniformly Distributed Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

Janbus Empirical Coef. is being used for the case of c & ϕ both > 0
100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between $X = 5.00$ ft.
and $X = 48.00$ ft.

Each Surface Terminates Between $X = 50.00$ ft.
and $X = 75.00$ ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is $Y = .00$ ft.

2.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	33.67	21.83
2	35.56	22.48
3	37.43	23.18
4	39.28	23.95
5	41.10	24.77
6	42.90	25.66
7	44.66	26.60
8	46.40	27.59
9	48.10	28.65
10	49.76	29.75
11	50.11	30.00

*** 1.499 ***

Individual data on the 15 slices

Slice No.	Width Ft(m)	Water Force		Tie Force	Tie Force	Earthquake Force		Surcharge	
		Weight Lbs(kg)	Top Lbs(kg)	Bot Lbs(kg)	Norm Lbs(kg)	Tan Lbs(kg)	Hor Lbs(kg)	Ver Lbs(kg)	Load Lbs(kg)
1	1.9	37.1	.0	.0	.0	.0	.0	.0	.0
2	1.4	72.9	.0	.0	.0	.0	.0	.0	.0
3	.4	28.3	.0	.0	.0	.0	.0	.0	176.9
4	1.8	146.6	.0	.0	.0	.0	.0	.0	757.5
5	1.8	173.5	.0	.0	.0	.0	.0	.0	747.0
6	1.8	182.6	.0	.0	.0	.0	.0	.0	735.8
7	1.8	174.7	.0	.0	.0	.0	.0	.0	723.8
8	.3	31.7	.0	.0	.0	.0	.0	.0	138.9
9	1.4	118.9	.0	.0	.0	.0	.0	.0	.0
10	1.6	106.1	.0	.0	.0	.0	.0	.0	.0
11	.1	5.1	.0	.0	.0	.0	.0	.0	.0
12	.5	25.9	.0	.0	.0	.0	.0	.0	.0
13	1.1	35.3	.0	.0	.0	.0	.0	.0	.0
14	.2	3.5	.0	.0	.0	.0	.0	.0	.0
15	.1	.6	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	28.89	19.44
2	30.85	19.82
3	32.80	20.27
4	34.73	20.80
5	36.64	21.41
6	38.52	22.08
7	40.37	22.84
8	42.19	23.66
9	43.98	24.56
10	45.73	25.52
11	47.44	26.56
12	49.11	27.66
13	50.74	28.82
14	52.25	30.00

*** 1.572 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	24.11	17.06
2	26.10	16.84
3	28.10	16.77
4	30.10	16.85
5	32.08	17.08
6	34.05	17.45
7	35.98	17.97
8	37.87	18.64
9	39.70	19.44
10	41.47	20.37
11	43.16	21.43
12	44.77	22.62
13	46.29	23.92
14	47.71	25.33
15	49.01	26.85
16	50.21	28.45
17	51.18	30.00

*** 1.579 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	28.89	19.44
2	30.87	19.75
3	32.83	20.15
4	34.77	20.63
5	36.68	21.20
6	38.57	21.86
7	40.43	22.60
8	42.25	23.42
9	44.04	24.32
10	45.78	25.31
11	47.47	26.37
12	49.12	27.51
13	50.71	28.72
14	52.25	30.00
15	52.25	30.00

*** 1.583 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	14.56	12.28
2	16.55	12.14
3	18.55	12.10
4	20.55	12.14
5	22.55	12.28
6	24.53	12.51
7	26.51	12.82
8	28.47	13.23
9	30.40	13.72
10	32.32	14.31
11	34.20	14.97
12	36.06	15.72
13	37.87	16.56
14	39.65	17.48
15	41.39	18.47
16	43.07	19.54
17	44.71	20.69
18	46.29	21.91
19	47.82	23.21
20	49.29	24.57
21	50.69	25.99
22	52.03	27.48
23	53.30	29.02
24	54.03	30.00

*** 1.604 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	28.89	19.44
2	30.89	19.42
3	32.89	19.54
4	34.87	19.80
5	36.83	20.21
6	38.75	20.75
7	40.63	21.42
8	42.46	22.23
9	44.23	23.17
10	45.92	24.23
11	47.54	25.41
12	49.07	26.71
13	50.50	28.10
14	51.82	29.60
15	52.13	30.00

*** 1.657 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	19.33	14.67
2	21.31	14.94
3	23.29	15.27
4	25.25	15.65
5	27.20	16.09
6	29.14	16.57
7	31.07	17.10
8	32.98	17.69
9	34.88	18.32
10	36.76	19.01
11	38.62	19.74
12	40.46	20.52
13	42.28	21.35
14	44.08	22.23
15	45.85	23.15
16	47.60	24.12
17	49.33	25.14
18	51.02	26.20
19	52.69	27.30
20	54.33	28.45
21	55.93	29.64
22	56.39	30.00

*** 1.659 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	14.56	12.28
2	16.55	12.08
3	18.54	11.97
4	20.54	11.96
5	22.54	12.02
6	24.54	12.18
7	26.52	12.42
8	28.49	12.76
9	30.45	13.17
10	32.38	13.68
11	34.30	14.27
12	36.18	14.94
13	38.03	15.69
14	39.85	16.53
15	41.63	17.44
16	43.36	18.44
17	45.05	19.50
18	46.70	20.65
19	48.29	21.86
20	49.82	23.14
21	51.30	24.49
22	52.72	25.90
23	54.07	27.37
24	55.36	28.90
25	56.20	30.00

*** 1.703 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	14.56	12.28
2	16.44	12.96
3	18.32	13.64
4	20.19	14.33
5	22.07	15.03
6	23.94	15.73
7	25.81	16.44
8	27.68	17.15
9	29.55	17.87
10	31.41	18.60
11	33.27	19.32
12	35.13	20.06
13	36.99	20.80
14	38.85	21.54
15	40.70	22.29
16	42.55	23.05
17	44.40	23.81
18	46.25	24.58
19	48.09	25.35
20	49.94	26.13
21	51.78	26.91
22	53.61	27.70
23	55.45	28.50
24	57.28	29.29
25	58.89	30.00

*** 1.735 ***

Failure Surface Specified By 5 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	43.22	26.61
2	45.09	27.33
3	46.92	28.13
4	48.71	29.03
5	50.44	30.00

*** 1.789 ***

.00	9.38	18.75	28.13	37.50	46.88
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9.38 +*

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- 5.7

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- 8.5.3632*

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APPENDIX D
SETTLEMENT CALCULATIONS



PROJECT NSW - Getcham and Hunt.
SUBJECT Landfill Settlement Model

Landfill
Please: (I)

(II)

(III)

(IV)

(V)
q = 1500
psf

q = 1500 psf

q = 1500 psf

q = 1500 psf

$$\gamma = 118$$
$$P_c = 1200 \text{ psf}$$
$$\frac{C_c}{1+e_0} = 0.12$$
$$\frac{C_{cr}}{1+e_0} = 0.02$$

$$\gamma = 130$$
$$P_c = 20,000$$
$$\frac{C_c}{1+e_0} = 0.03$$
$$\frac{C_{cr}}{1+e_0} = 0.03$$

$$\gamma = 130 \text{ pcf}$$
$$P_c = 15,000 \text{ psf}$$
$$\frac{C_c}{1+e_0} = 0.16$$
$$\frac{C_{cr}}{1+e_0} = 0.004$$

$$P_c = 2500$$

$$P_c = 3800$$

$$P_c = 5100 \text{ psf}$$

$$P_c = 6400 \text{ psf}$$

$$P_c = 77 \text{ psf}$$

SETTLEMENT ANALYSIS

***** **

Job Name: Northwestern Steel RCRA Landfill

Job No. : 20480,031.23

Filename : NSW_1

Bearing Pressure (psf): 1500

Footing Type: 2 (1=Spread ; 2=Strip)

Footing Width (ft): 200.00

Footing Depth (ft): 1.00

Date : 09-26-91

Cal'd By : SAH

Checked : *SAH*

Gr.Water Depth (ft): 20.00

Stress Distribution: 1 (1=Westergaard ; 2=Boussinesq)

Assumptions:

PHASE I

ULTIMATE SETTLEMENT (inches)

DEPTH BELOW G.S. (feet)	AVE. DEPTH (feet)	TOTAL UNIT WEIGHT (pcf)	OVER- BURDEN PRESS. [OBP] (psf)	PRECONS PRESS. (psf)	VIRGIN Cc 1+ E_o	RECOMPR Cc 1+ E_o	AVE. DEPTH FOOTING WIDTH	INFLUENC FACTOR	DELTA P + OBP	VIRGIN CURVE	RECOMPR *	TOTAL
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
0	0.5	118	---	---	---	---	---	---	---	---	*	---
1	3.0	118	354	1200	0.120	0.020	0.010	0.9999	1854	1.09	0.51 *	1.60
5	7.5	118	885	1200	0.120	0.020	0.033	0.9999	2385	2.15	0.16 *	2.31
10	12.5	130	1505	20000	0.030	0.030	0.058	0.9987	3003	0.00	0.54 *	0.54
15	17.5	130	2155	20000	0.030	0.030	0.083	0.9633	3600	0.00	0.40 *	0.40
20	22.5	130	2649	20000	0.030	0.030	0.108	0.9103	4014	0.00	0.32 *	0.32
25	27.5	130	2987	20000	0.030	0.030	0.133	0.8881	4319	0.00	0.29 *	0.29
30	32.5	130	3325	20000	0.030	0.030	0.158	0.8743	4636	0.00	0.26 *	0.26
35	37.5	130	3663	20000	0.030	0.030	0.183	0.8530	4943	0.00	0.23 *	0.23
40	0.0		0				0.000	ERR	ERR	0.00	0.00 *	0.00
	0.0		0				0.000	ERR	ERR	0.00	0.00 *	0.00
	0.0		0				0.000	ERR	ERR	0.00	0.00 *	0.00
TOTALS:										3.24	2.72	5.95

Clay/Silt

Sand

SETTLEMENT ANALYSIS

***** **

Job Name: Northwestern Steel RCRA Landfill

Job No. : 20480,031.23

Filename : NSW_2B

Bearing Pressure (psf): 1500
 Footing Type: 2 (1=Spread ; 2=Strip)
 Footing Width (ft): 200.00
 Footing Depth (ft): 1.00

Date : 09-30-91
 Cal'd By : SAH
 Checked : *GA*

Gr.Water Depth (ft): 10.00
 Stress Distribution: 1 (1=Westergaard ; 2=Boussinesq)

Assumptions: PHASE II

ULTIMATE SETTLEMENT (inches)

DEPTH BELOW G.S. (feet)	AVE. DEPTH (feet)	TOTAL UNIT WEIGHT (pcf)	OVER- BURDEN PRESS. [OBP] (psf)	PRECONS PRESS. (psf)	VIRGIN Cc 1+Eo	RECOMPR Ccr 1+Eo	AVE. DEPTH FOOTING WIDTH	INFLUENC FACTOR	DELTA P + OBP	VIRGIN CURVE	RECOMPR *	TOTAL
0	0.5	130										
1	3.0	130	390	15000	0.160	0.004	0.010	0.9999	1890	0.00	0.13 *	0.13
5	7.5	130	975	15000	0.160	0.004	0.033	0.9999	2475	0.00	0.10 *	0.10
10	12.5	118	1439	1439	0.120	0.020	0.058	0.9987	2937	2.23	0.00 *	2.23
15	17.5	118	1717	1717	0.120	0.020	0.083	0.9633	3162	1.91	0.00 *	1.91
20	22.5	130	2025	20000	0.030	0.030	0.108	0.9103	3390	0.00	0.40 *	0.40
25	27.5	130	2363	20000	0.030	0.030	0.133	0.8881	3695	0.00	0.35 *	0.35
30	32.5	130	2701	20000	0.030	0.030	0.158	0.8743	4012	0.00	0.31 *	0.31
35	37.5	130	3039	20000	0.030	0.030	0.183	0.8530	4319	0.00	0.27 *	0.27
40	45.0	130	3546	20000	0.030	0.030	0.220	0.8244	4783	0.00	0.47 *	0.47
50	0.0		0				0.000	ERR	ERR	0.00	0.00 *	0.00
	0.0		0				0.000	ERR	ERR	0.00	0.00 *	0.00
TOTALS:										4.14	2.03	6.17

Waste

Clay/Silt

Sand

SETTLEMENT ANALYSIS

***** **

Job Name: Northwestern Steel RCRA Landfill

Job No. : 20480,031.23

Filename : NSW_3B

Bearing Pressure (psf): 1500
 Footing Type: 2 (1=Spread ; 2=Strip)
 Footing Width (ft): 200.00
 Footing Depth (ft): 1.00

Date : 09-30-91
 Cal'd By : SAH
 Checked : *FLA*

Gr.Water Depth (ft): 20.00
 Stress Distribution: 1 (1=Westergaard ; 2=Boussinesq)

Assumptions: PHASE III

DEPTH BELOW G.S. (feet)	AVE. DEPTH (feet)	TOTAL UNIT WEIGHT (pcf)	OVER- BURDEN PRESS. [OBP] (psf)	PRECONS PRESS. (psf)	VIRGIN Co 1+ Eo	RECOMPR Cor 1+ Eo	AVE. DEPTH FOOTING WIDTH	INFLUENC FACTOR	DELTA P + OBP	ULTIMATE SETTLEMENT (inches)		
										VIRGIN CURVE	RECOMPR	TOTAL
0	0.5	130										
1	3.0	130	390	15000	0.160	0.004	0.010	0.9999	1890	0.00	0.13 *	0.13
5	7.5	130	975	15000	0.160	0.004	0.033	0.9999	2475	0.00	0.10 *	0.10
10	12.5	130	1625	15000	0.160	0.004	0.058	0.9987	3123	0.00	0.07 *	0.07
15	17.5	130	2275	15000	0.160	0.004	0.083	0.9633	3720	0.00	0.05 *	0.05
20	22.5	118	2739	2739	0.120	0.020	0.108	0.9103	4104	1.26	0.00 *	1.26
25	27.5	118	3017	3017	0.120	0.020	0.133	0.8881	4349	1.14	0.00 *	1.14
30	32.5	130	3325	20000	0.030	0.030	0.158	0.8743	4636	0.00	0.26 *	0.26
35	37.5	130	3663	20000	0.030	0.030	0.183	0.8530	4943	0.00	0.23 *	0.23
40	45.0	130	4170	20000	0.030	0.030	0.220	0.8244	5407	0.00	0.41 *	0.41
50	55.0	130	4846	20000	0.030	0.030	0.270	0.7837	6022	0.00	0.34 *	0.34
60	0.0		0				0.000	ERR	ERR	0.00	0.00 *	0.00
TOTALS:										2.41	1.59	4.00

Waste

Clay/Silt

Sand

SETTLEMENT ANALYSIS

***** **

Job Name: Northwestern Steel RCRA Landfill

Job No. : 20480,031.23

Filename : NSW_4B

Bearing Pressure (psf): 1500
 Footing Type: 2 (1=Spread ; 2=Strip)
 Footing Width (ft): 200.00
 Footing Depth (ft): 1.00

Date : 09-30-91
 Cal'd By : SAH
 Checked : *GA*

Gr.Water Depth (ft): 30.00
 Stress Distribution: 1 (1=Westergaard ; 2=Boussinesq)

Assumptions: PHASE IV

										ULTIMATE SETTLEMENT (inches)		
DEPTH BELOW G.S. (feet)	AVE. DEPTH (feet)	TOTAL UNIT WEIGHT (pcf)	OVER- BURDEN PRESS. [OBP] (psf)	PRECONS PRESS. (psf)	VIRGIN Co 1+Eo	RECOMPR Ccr 1+Eo	AVE. DEPTH FOOTING WIDTH	INFLUENC FACTOR	DELTA P + OBP	VIRGIN CURVE	RECOMPR *	TOTAL
0	0.5	130									*	
1	3.0	130	390	15000	0.160	0.004	0.010	0.9999	1890	0.00	0.13 *	0.13
5	7.5	130	975	15000	0.160	0.004	0.033	0.9999	2475	0.00	0.10 *	0.10
10	12.5	130	1625	15000	0.160	0.004	0.058	0.9987	3123	0.00	0.07 *	0.07
15	17.5	130	2275	15000	0.160	0.004	0.083	0.9633	3720	0.00	0.05 *	0.05
20	22.5	130	2925	15000	0.160	0.004	0.108	0.9103	4290	0.00	0.04 *	0.04
25	27.5	130	3575	15000	0.160	0.004	0.133	0.8881	4907	0.00	0.03 *	0.03
30	32.5	118	4039	4039	0.120	0.020	0.158	0.8743	5350	0.88	0.00 *	0.88
35	37.5	118	4317	4317	0.120	0.020	0.183	0.8530	5597	0.81	0.00 *	0.81
40	45.0	130	4794	20000	0.030	0.030	0.220	0.8244	6031	0.00	0.36 *	0.36
50	55.0	130	5470	20000	0.030	0.030	0.270	0.7837	6646	0.00	0.30 *	0.30
60	65.0	130	6146	20000	0.030	0.030	0.320	0.7323	7244	0.00	0.26 *	0.26
70												
TOTALS:										1.69	1.34	3.03

Waste

Clay/Silt

Sand

SETTLEMENT ANALYSIS

***** **

Job Name: Northwestern Steel RCRA Landfill

Job No. : 20480,031.23

Filename : NSW_5B

Bearing Pressure (psf): 1500
 Footing Type: 2 (1=Spread ; 2=Strip)
 Footing Width (ft): 200.00
 Footing Depth (ft): 1.00

Date : 09-30-91
 Cal'd By : SAH
 Checked : *SLA*

Gr. Water Depth (ft): 40.00
 Stress Distribution: 1 (1=Westergaard ; 2=Boussinesq)

Assumptions: PHASE V

DEPTH BELOW G.S. (feet)	AVE. DEPTH (feet)	TOTAL UNIT WEIGHT (pcf)	OVER- BURDEN PRESS. [OBP] (psf)	PRECONS PRESS. (psf)	VIRGIN Cc 1+ Eo	RECOMPR Ccr 1+ Eo	AVE. DEPTH FOOTING WIDTH	INFLUENC FACTOR	DELTA P + OBP	ULTIMATE SETTLEMENT (Inches)		
										VIRGIN CURVE	RECOMPR	TOTAL
0	0.5	130										
1	3.0	130	390	15000	0.160	0.004	0.010	0.9999	1890	0.00	0.13 *	0.13
5	7.5	130	975	15000	0.160	0.004	0.033	0.9999	2475	0.00	0.10 *	0.10
10	12.5	130	1625	15000	0.160	0.004	0.058	0.9987	3123	0.00	0.07 *	0.07
15	17.5	130	2275	15000	0.160	0.004	0.083	0.9633	3720	0.00	0.05 *	0.05
20	22.5	130	2925	15000	0.160	0.004	0.108	0.9103	4290	0.00	0.04 *	0.04
25	27.5	130	3575	15000	0.160	0.004	0.133	0.8881	4907	0.00	0.03 *	0.03
30	35.0	130	4550	15000	0.160	0.004	0.170	0.8530	5830	0.00	0.05 *	0.05
40	45.0	118	5478	5478	0.120	0.020	0.220	0.8244	6715	1.27	0.00 *	1.27
50	55.0	130	6094	20000	0.030	0.030	0.270	0.7837	7270	0.00	0.28 *	0.28
60	65.0	130	6770	20000	0.030	0.030	0.320	0.7323	7868	0.00	0.24 *	0.24
70	75.0	130	7446	20000	0.030	0.030	0.370	0.6971	8492	0.00	0.21 *	0.21
80												
TOTALS:										1.27	1.19	2.46

Waste

Clay / Silt

Sand

SETTLEMENT ANALYSIS

***** **

Job Name: Northwestern Steel RCRA Landfill

Job No. : 20480,031.23

Filename : NSW_CVRB

Bearing Pressure (psf): 1000
 Footing Type: 2 (1=Spread ; 2=Strip)
 Footing Width (ft): 200.00
 Footing Depth (ft): 1.00

Date : 09-30-91

Cal'd By : SAH

Checked : *SAH*

Gr.Water Depth (ft): 50.00
 Stress Distribution: 1 (1=Westergaard ; 2=Boussinesq)

Assumptions: CLOSURE CAP

DEPTH BELOW G.S. (feet)	AVE. DEPTH (feet)	TOTAL UNIT WEIGHT (pcf)	OVER- BURDEN PRESS. [OBP] (psf)	PRECONS PRESS. (psf)	VIRGIN Cc 1+Eo	RECOMPR Ccr 1+Eo	AVE. DEPTH FOOTING WIDTH	INFLUENC FACTOR	DELTA P + OBP	ULTIMATE SETTLEMENT (Inches)		
										VIRGIN CURVE	RECOMPR	TOTAL
0	0.5	130										
1	3.0	130	390	15000	0.160	0.004	0.010	0.9999	1390	0.00	0.11 *	0.11
5	7.5	130	975	15000	0.160	0.004	0.033	0.9999	1975	0.00	0.07 *	0.07
10	12.5	130	1625	15000	0.160	0.004	0.058	0.9987	2624	0.00	0.05 *	0.05
15	17.5	130	2275	15000	0.160	0.004	0.083	0.9633	3238	0.00	0.04 *	0.04
20	25.0	130	3250	15000	0.160	0.004	0.120	0.9008	4151	0.00	0.05 *	0.05
30	35.0	130	4550	15000	0.160	0.004	0.170	0.8530	5403	0.00	0.04 *	0.04
40	45.0	130	5850	15000	0.160	0.004	0.220	0.8244	6674	0.00	0.03 *	0.03
50	55.0	118	7700	7700	0.120	0.020	0.270	0.7837	8484	0.61	0.00 *	0.61
60	65.0	130	8316	20000	0.030	0.030	0.320	0.7323	9048	0.00	0.13 *	0.13
70	75.0	130	8992	20000	0.030	0.030	0.370	0.6971	9689	0.00	0.12 *	0.12
80	85.0	130	9668	20000	0.030	0.030	0.420	0.6526	10321	0.00	0.10 *	0.10
90												
TOTALS:										0.61	0.73	1.34

Waste

Clay / Silt

Sand



PROJECT NSW Landfill - Geotech
SUBJECT Time Rate of Settlement

Native Silts / Clays

Ref.: Peck, Hansen & Thornburg

$$C_v = \frac{T_v}{t} H^2$$

$$t = \frac{T_v H^2}{C_v}$$

$$C_v = 680 \frac{\text{in}^2}{\text{months}} \quad (\text{From lab test})$$

$$\checkmark T_v = 0.85 \quad (@ 90\% \text{ consolidation})$$

$$H = 5' = 60" \quad (\text{Based on logs \& judgement})$$

$$\Rightarrow t_{90} = \frac{0.85 (60)^2}{680 \frac{\text{in}^2}{\text{mo}}} = 4.5 \text{ months } \checkmark \quad (90\% \text{ consolidation})$$

$$\checkmark t_{50} = \frac{0.20 (60)^2}{680} = 1.1 \text{ months } \checkmark \quad (50\% \text{ consolidation})$$

$$t_{75} = \frac{0.50 (60)^2}{680} = 2.7 \text{ months } \checkmark \quad (75\% \text{ consolidation})$$

Sands

- Free draining \therefore essentially immediate

Waste Material

$$C_v = 225 \frac{\text{in}^2}{\text{month}} \quad (\text{from lab test})$$

$$\text{Say: } H = 5' = 60" \quad (1/2 \text{ of lift thickness})$$

$$\Rightarrow t_{90} = \frac{0.85 (60)^2}{225} = 14 \text{ months } \checkmark \quad (90\% \text{ consol.})$$

$$t_{50} = \frac{0.20 (60)^2}{225} = 3.3 \text{ months } \checkmark \quad (50\% \text{ consol.})$$

$$t_{75} = \frac{0.50 (60)^2}{225} = 8.2 \text{ months } \checkmark \quad (75\% \text{ consol.})$$

DISTRIBUTION

DESIGN DEVELOPMENT REPORT
STABILIZED POLLUTION CONTROL SLUDGE
LANDFILL EXPANSION
JANUARY 1992

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QUALITY CONTROL REVIEWER: Ronald Owes
Consulting Principal Engineer

DESIGN/OPERATIONS CONCEPTS
RCRA LANDFILL EXPANSION

NORTHWESTERN STEEL AND WIRE COMPANY

ILD005263157

OCTOBER 1, 1991

DESIGN/OPERATIONS CONCEPTS
RCRA LANDFILL EXPANSION
NORTHWESTERN STEEL AND WIRE
October 1, 1991

I. Vertical Expansion of Landfill

- A. Regulatory requirement: No lateral expansion.
- B. Stepped berms constructed of compacted fill derived locally (Plate 1).
- C. 10 foot high lifts, phased over time. Reference design concept drawings (Plates 2 through 5) for the phasing and design details.
- D. Estimated 5 lifts for 20 years additional capacity (assumes 35,000 tons/year of K061 waste, placed at 115 pcf).
- E. Luger trucks climb access road, drive on top of berm (15 feet wide) and back onto unloading pads, where they dump the waste material to surface below.
- F. Waste spread and compacted with bulldozer or endloader.

II. Run-on Control

- A. Regulatory requirement: Facility design must prevent surface water run-on onto the waste material
- B. Berms will prevent run-on from entering landfill

III. Run-off Control

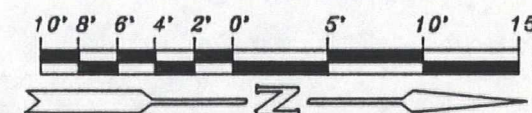
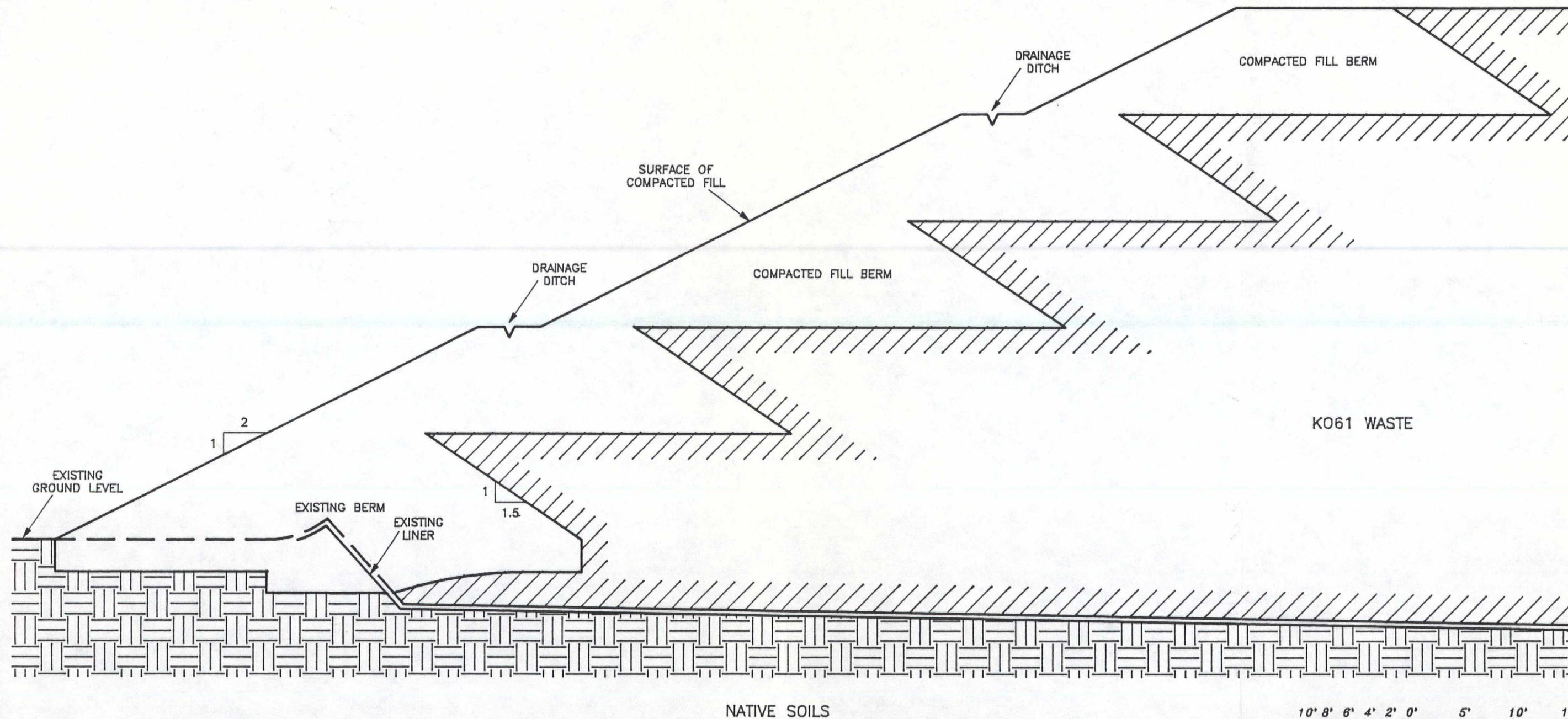
- A. Regulatory requirement: Any surface water falling within the landfill must meet NPDES requirements prior to discharge to surface water. Design to consider 25 year, 24 hour storm.
- B. Volume of run-off will decrease as the landfill deck area decreases.
- C. Operate and phase the landfill to direct surface run-off to low points located in the middle of the cells. Low points will not be incorporated until completion of Phase 1, avoiding potential damage to the existing liner system.
- D. Sediment will be allowed to settle in the low point. Water will then either be discharged to surface water, used as process water, or used for dust control.
- E. Run-off Control Facilities:
 - Low points.
 - Valved outlet works connected to cell C.

IV. Dust Control

- A. Use simple, manually operated irrigation equipment for dust control.
- B. Use water captured within the landfill.

V. Closure

- A. A cap will be constructed on the final top deck upon completion of waste placement in each cell (Plates 6 and 7). The cap will consist of: minimum 2 feet of soil fill over a 20 mil flexible membrane liner over 2 feet of low permeability soil layer.
- B. The cap will direct surface water runoff to the landfill perimeter.



Harding Lawson Associates
Engineering and
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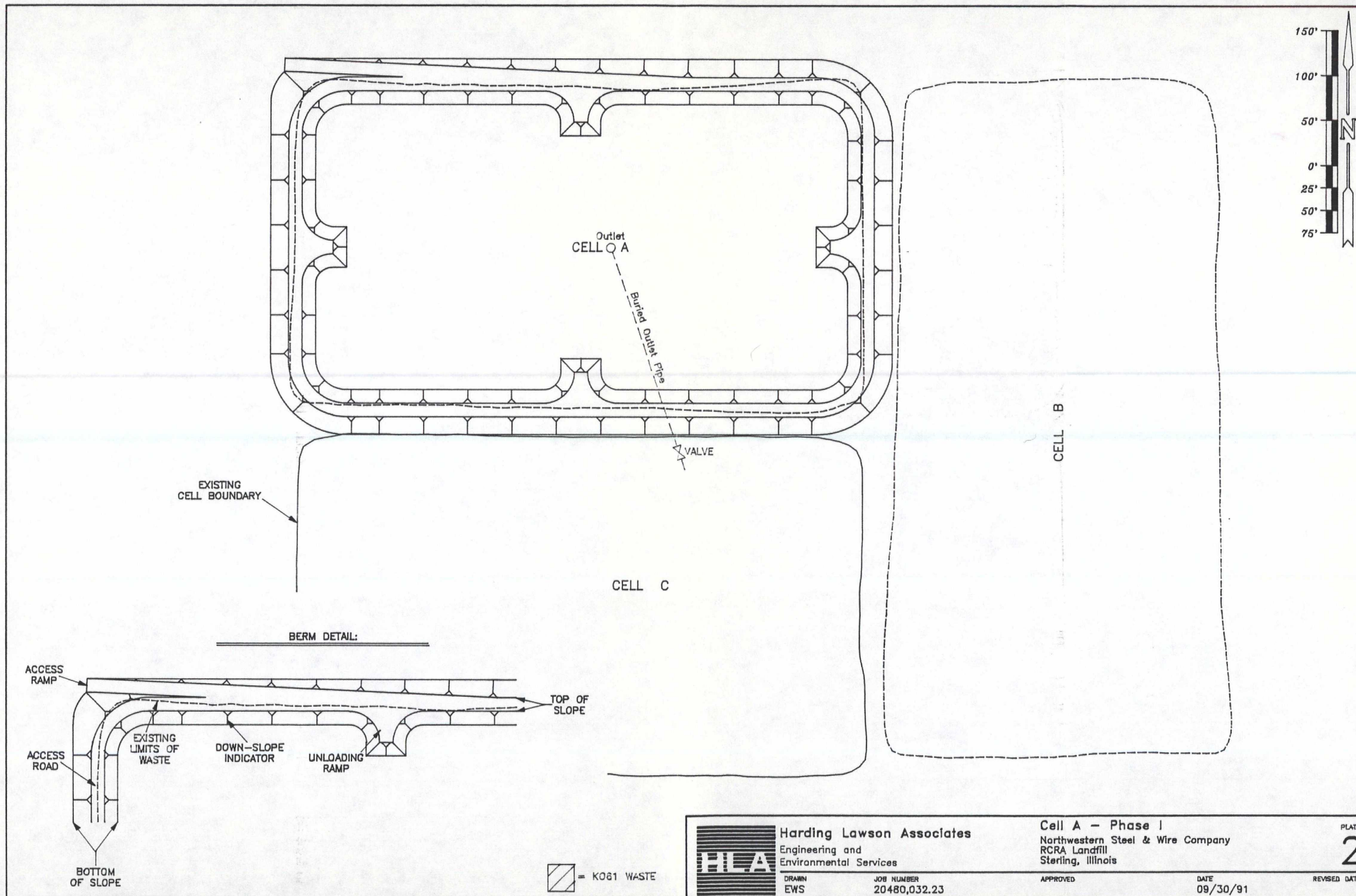
Landfill Berm Detail
Northwestern Steel & Wire Company
RCRA Landfill
Sterling, Illinois

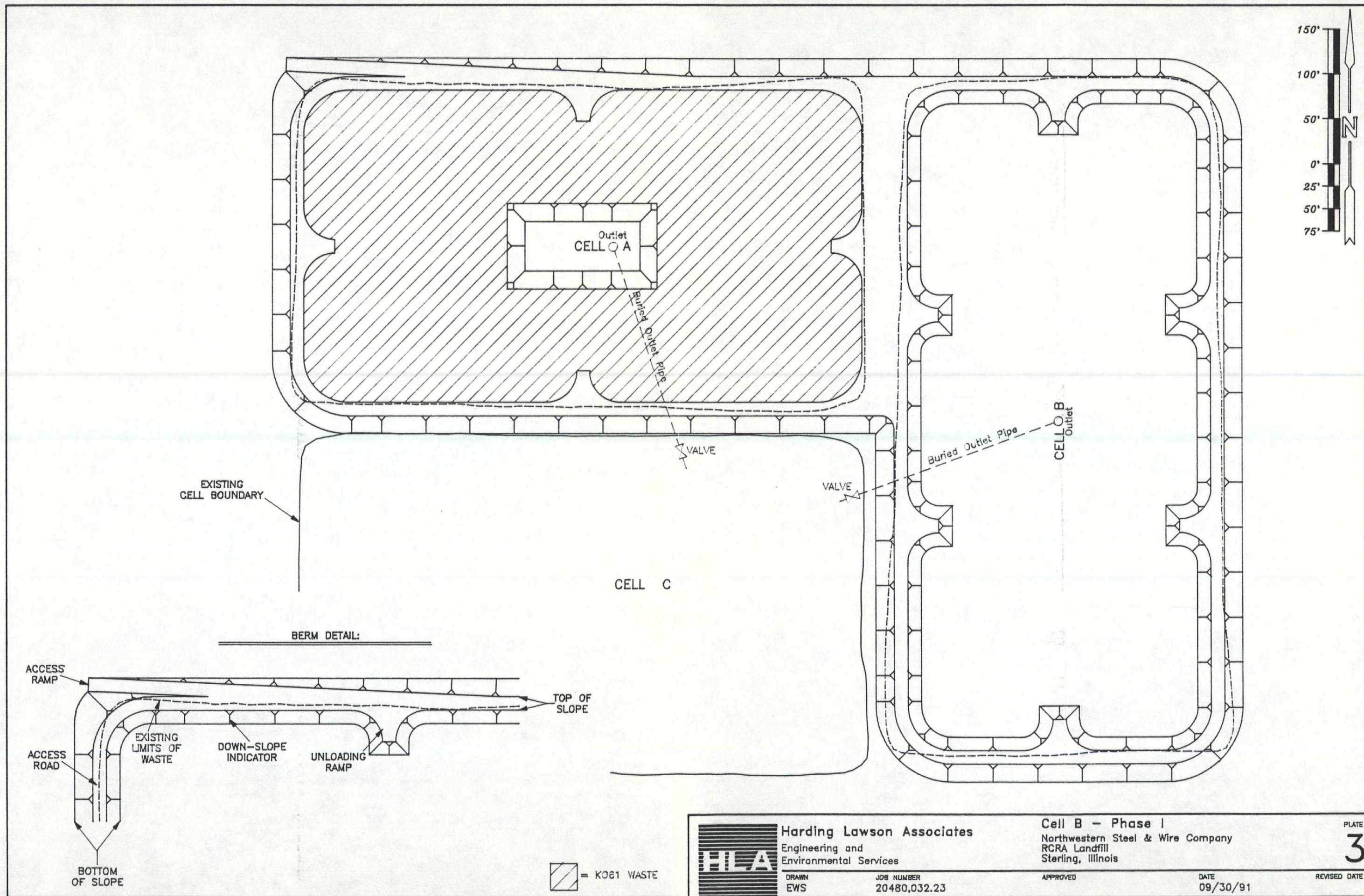
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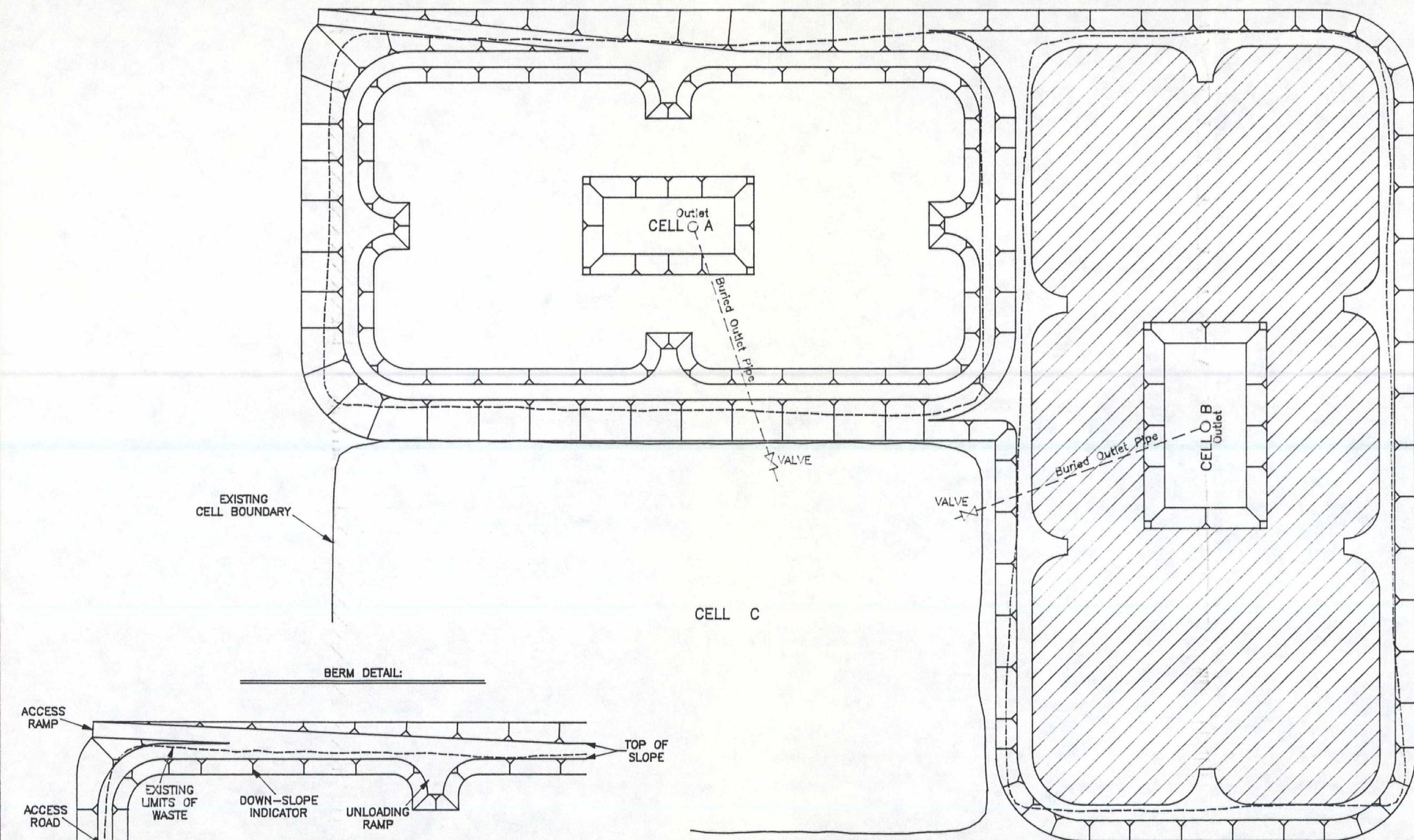
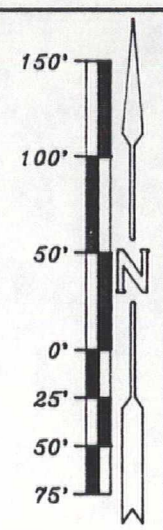
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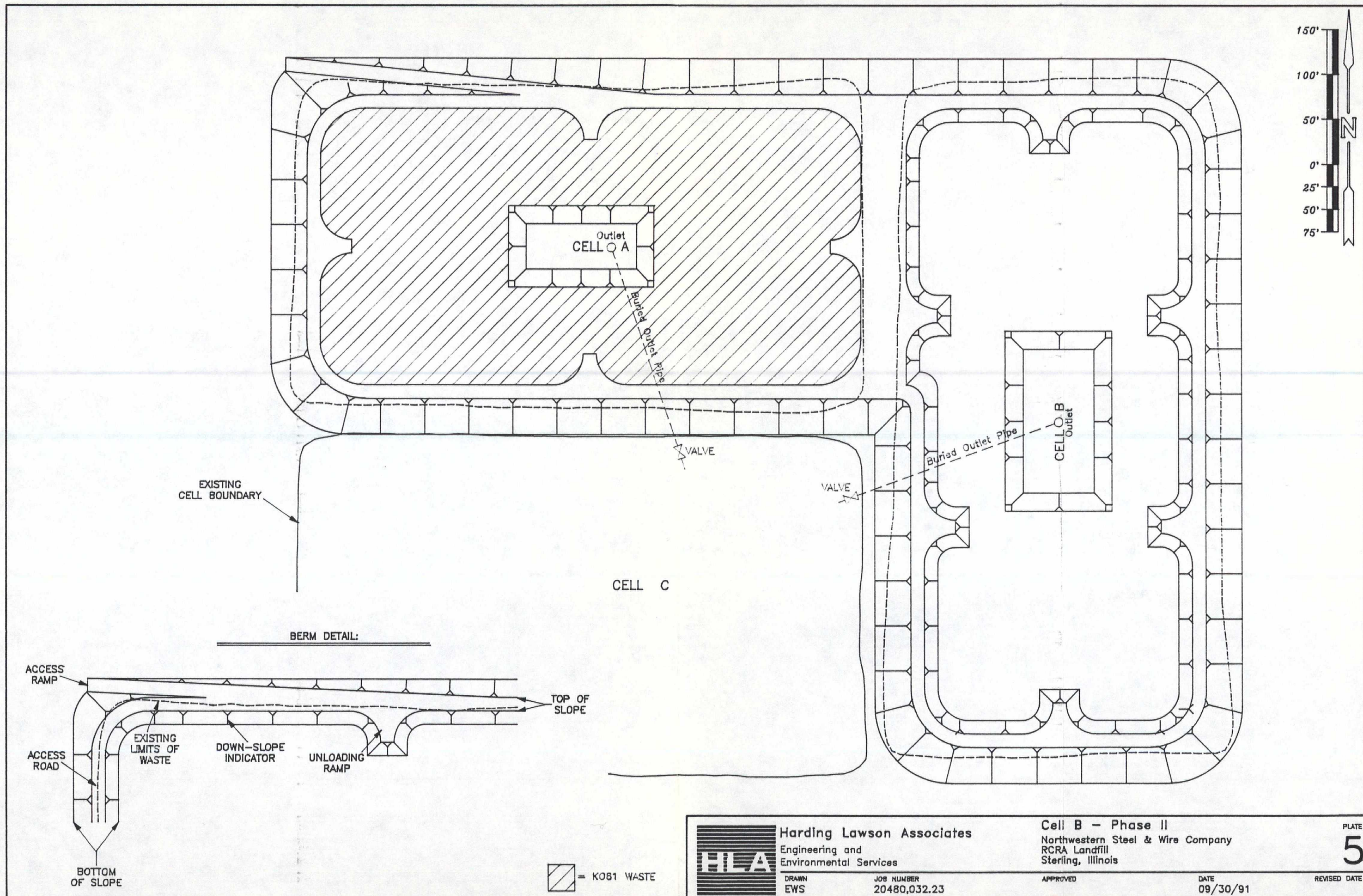
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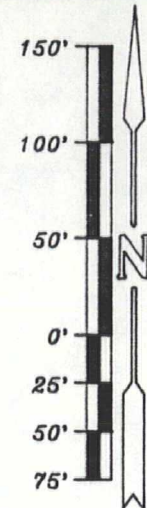
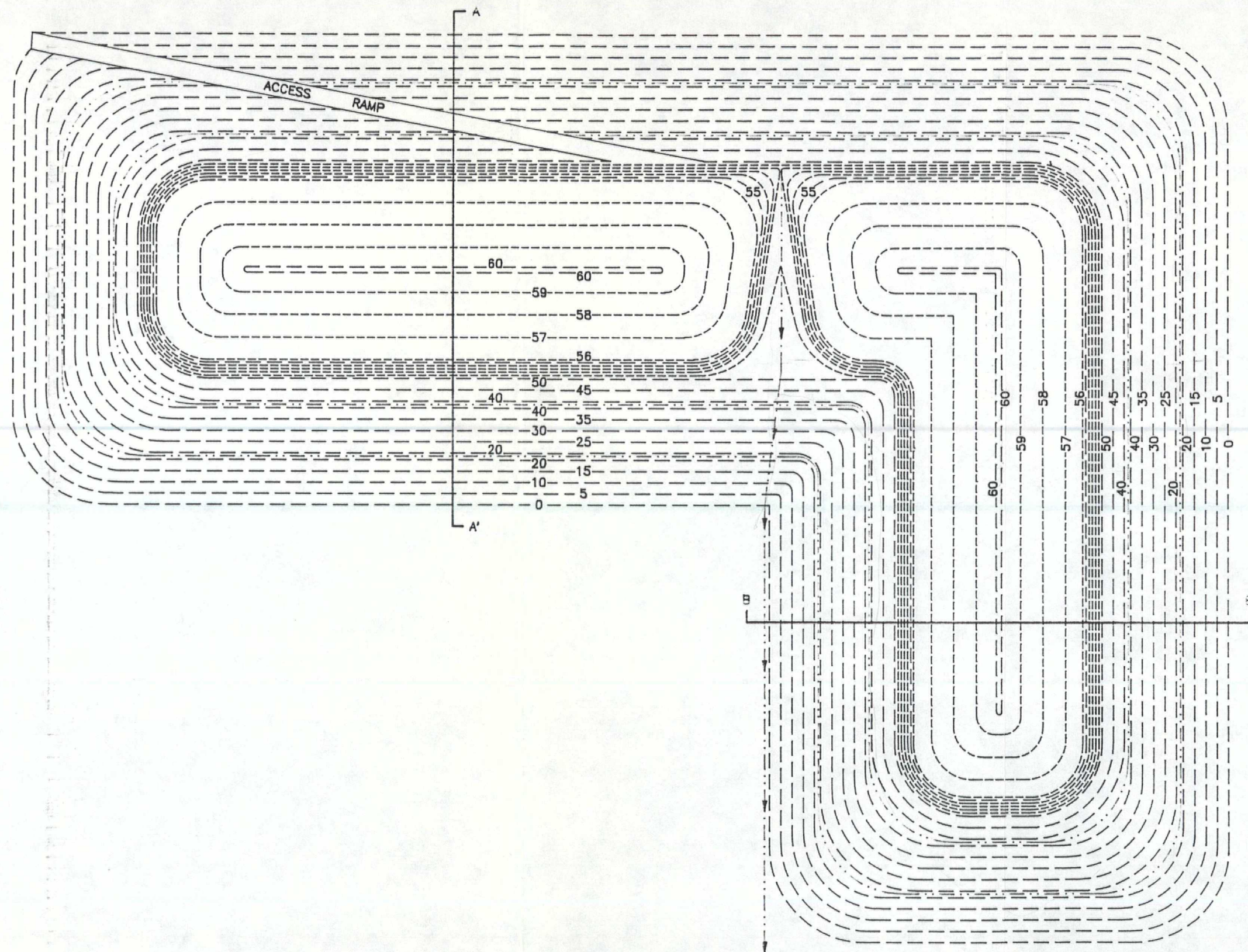
PLATE
1











NOTE:
BOTTOM OF BERM ELEVATION OF '0' FEET
EQUALS ACTUAL ELEVATION OF '638' FEET

- = 1' CONTOUR LINE
- = 5' CONTOUR LINE
- = DRAINAGE DITCH
- = CROSS-SECTION



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Closure Plan - Final Contours
Northwestern Steel & Wire Company
RCRA Landfill
Sterling, Illinois

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PLATE

6

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